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Cost Keeping.

There is no inquiry which comes to this office more often than the request for sources of information on machine shop cost-keeping, and we are gratified to be able to present the article on that subject of which the concluding portion appears in this issue, and which gives a full description of the methods used in one of our foremost machine shops, the class of work done being the manufacture of engines, mining, smelting, ore-reduction and milling machinery. The article has the further important feature that it was written by the man—a practical mechanic—who devised, installed and operated the plan described. We think our readers will agree with us that it bears throughout the stamp of a man who has actually handled the problem and done the work.

Those who have given the subject attention will perhaps consider the article in some respects as unnecessarily elementary, but we are convinced, from the nature of the inquiries which we receive, that this is just the treatment which most inquirers want.

In spite of his very striking illustration of the failure of the percentage burden plan to meet a specific set of conditions, we very much doubt if Mr. Thomas will succeed in inducing the advocates of that plan to change their ways. Taken by itself, the illustration is convincing, but the trouble is that just as striking illustrations of the failure of the hourly burden plan to meet other specific conditions can be drawn. The factor which that plan fails to consider is the variation in the interest and depreciation charge on tools of different values. The hourly burden plan, as described, would charge the same burden factor against a $10,000 boring mill that it would against a $100 centering machine, although the simple interest and depreciation charge alone, at the low combined rate of 10 per cent. per annum, would equal $3.33⅓ per day (the year being considered as composed of 300 working days) for the boring mill, against 3⅓ cents per day for the centering machine. This is a difference in cost of $3.30 per day which the hourly burden plan entirely ignores; but even this is not all, for the boring mill consumes more power, occupies a larger amount of real estate, and requires the frequent service of a crane.

It cannot be claimed, of course, that the percentage burden plan covers this factor with any approach to accuracy, but we think its advocates base their preference for it on the ground that, outside of toolroom work, which is not properly to be considered, as it is not made to sell, the more expensive tools are, as a rule, operated by the higher-priced men, and thus, in a rough and ready way, the percentage burden plan makes some provision for the interest and depreciation factor.

Another feature which leads some to prefer the percentage plan is the fact that it is somewhat simpler. With that plan we are concerned with the hours of time consumed up to the point where the workman's wages have been determined only. Beyond that point records and determination of detailed and final costs are based wholly on the amounts paid out. The determination of the final cost involves nothing more than the footing of the wages and material costs and the addition of the required percentage to the total. With the hourly plan the record of the hours must be kept all through, and both wages and hours must be footed in finding the final cost.

It must be confessed, we think, that neither plan is satisfactory enough to get enthusiastic over, and, in fact, no plan can really charge the various expense items where they belong. The charge for rent should properly be based on the ground-floor space occupied by each machine, the charge for interest and depreciation on the cost, and the charges for power and supplies on the amounts used. To attempt to so apportion the various charges would be simply absurd, and that plan is best which most nearly approximates accuracy.

What holds most manufacturers to the two plans named, with all their imperfections, is the fact that while they do not and cannot divide the expense item accurately, they do, if properly administered, divide it. That is to say, it is easily possible by either plan to find a correct total of the expense item and then charge it all against something—it is easy to make sure that no items of expense are overlooked. Even if the total is not correctly divided among the different jobs, a great point is gained if we may be sure that at the end of the year the total expense charged against the work done during the year is the correct total of the expense incurred, and this either plan will do.

Probably the greatest deficiency of both plans is their failure to deal as they should with the interest and depreciation factor. As we have seen, the hourly plan ignores this altogether, and the percentage plan treats it in a way which can only be tolerated in the absence of something better. In shops doing small and medium work only, and hence having no very large or costly tools, this factor is of comparatively small importance. In such shops we think there is little doubt that the hourly plan is best and for the reasons so graphically given by Mr. Thomas. In shops doing very large work and fitted with corresponding tools, the interest and depreciation item may easily become by far the most important factor of all in the expense account, and we have yet to see a completely satisfactory method of dealing with it.

In this connection we may refer to an extremely suggestive article published in our issue of July 27, 1899, in which the methods of the Newton Machine Tool Works were described. In those works a graded series of charges is made to cover

all tools in the shop, this charge including the workman's wages. Indeed, the workman's time is taken only for the purpose of the pay roll, the wages not appearing at all in the cost accounts, and the amounts charged to the work being based on the tool time and the rates per hour for each tool. The methods employed are, moreover, simple and practicable to the last degree.

It is clear that by this method the interest and depreciation factor may be divided and charged to the different jobs with substantial accuracy, but we fail to see what assurance there is that the total expenses charged during the year will equal the total incurred. Some such system of graded charges for tools of different values is, however, essential if the cost of operating expensive tools is to be charged where it belongs, and a sytsem could be devised which would do it. As we have said, the interest and depreciation charge is a small factor on small and medium sized tools, and for them the charge could be made on the plan described by Mr. Thomas without material error. If all tools costing less than, say, $1,000 were classed together and treated in this manner, the method would be satisfactory for them, and the great bulk of the work done would be covered. The larger tools might then be treated each by itself, and charged first with the general burden to cover other expenses than interest and depreciation, and then with a special burden to cover their own interest and depreciation. The general burden, including the interest and depreciation charge for the smaller tools, would overcharge the large tools so far as interest and depreciation are concerned, but some such additional charge is necessary to cover such expenses as increased real estate occupied and crane service. A record of the hours run by the tools treated in this way would have to be kept, and this would be the chief additional clerical labor involved. Such a system could be worked out, and in works having many large tools we are disposed to think that it would be worth the doing. With such a feature added, the hourly burden plan would appear to meet all requirements.

Our readers will see that we have not attempted to settle the battle of the burdens, but rather to show the shortcomings of both plans as commonly applied. They will also see that preference for the percentage plan does not materially reduce the value of Mr. Thomas' article to the reader, for, with slight modification, the methods shown may be adapted to that plan.

The New Labor Organization in the Machinery Trade.

We publish in another column of this issue a letter from a well-known manufacturer, of Columbus, Ohio, who, we infer, took a prominent part in the initiatory steps looking to the formation of the Machine Trades and Professions Association. There was a time when it was hoped, and by many believed, that organizations, on either side, of those engaged in machine constructive operations would not be needed and could never gain headway enough to be a seriously disturbing factor in the business. The leaders of thought on both sides seemed to hold the opinion that the high order of intelligence required for the business would enable the men engaged in it who might have differences, to adjust them without serious difficulty and without a resort to force. Time has shown that that view was a little too optimistic. Organizations have been formed and bitter contests have been waged. But, nevertheless, the brains, possessed by workmen as well as by employers, have been in evidence all along, and the movement referred to by Mr. Jeffrey gives additional proof that such difficulties as may be expected to arise in the future will be dealt with by the application of these brains; *i. e.*, by reason and mutual respect, rather than by brute force—an attempt to see which side can stand the loss resulting from a strike or lock-out longest.

Our readers know that we believe in good wages for those who construct machinery. Not only do we believe that high rather than low wages are best for the industry generally, but we further believe that, other things equal, the establishment that pays a little higher wages than others in the same line will produce its goods cheapest. We believe that very many employers who have given attention to this matter also take this view of it; but we think that any attempt to restrict the amount of work done or to enforce the "one man one machine" rule is not only wrong, but that it will prove as disastrous here as it did in England. Machinists live upon the willingness of others to progress—to use machinery in place of hand labor and then to displace that machinery for later and more improved machinery whenever it can be shown to be economical to do so. It is manifestly absurd for machinists to refuse to "take their own medicine." Not only is it absurd for them to do so, but it will always, in the end, fail, because it is contrary to economic laws and against the current of the times. It is right, we think, for labor organizations to attempt to protect their members from actual overwork. A workman's capital lies in his capacity to do work, and those who have good sense enough to avoid a too rapid outgo of vitality ought to be protected from the competition of those who have not such sense or who can be driven to continuous overexertion; but to say that a man performing perhaps two hours of actual labor per day shall not do more, because, in order to do so, he must run two or more machines, is to take a position that cannot be maintained; and which, if it could, would in the end tend to lower wages instead of to raise them.

Such questions as the premium plan, for instance, must be considered on their merits, and not condemned because they at first glance may seem to conflict with some pronunciamento of a labor union. In this connection it might be well to remind some of those who have written complaining letters regarding our attitude on this matter that the freely expressed opinion of a journal known to be independent and unpledged is the only one that carries any weight whatever or can do any good in securing "a hearing for the other side" when a question is in dispute. The "American Machinist" is not obliged to take any particular view on a matter pertaining to the machinery interests, nor to consult anyone or any organization before expressing its views. It intends, however, to be reasonable and fair, and herein lies the value or utility of whatever it may have to say, one way or the other.

Report of Constructor Hichborn.

The report of Rear Admiral Hichborn Chief of the Bureau of Construction and Repair of the United States Navy, for the fiscal year 1899-1900, is of special interest from the fact that it is the last report that he will make, as he retires on March 4 next. He tells us in the report that he began as a government apprentice and was employed upon the construction of the Merrimac and the Hartford. He very naturally indulges in some reminiscences, alluding briefly to the vast transformations which shipbuilding and allied industries have undergone during his career.

"How many of those associated with the work of this period, looking into the future, would have believed that during the space represented by the active career of one man, wooden ships of war and sails as a means of propulsion would have passed; that steel should have become the material of construction, steam the one propelling power; and electricity a general agent on shipboard; that the demands for protection, armament, speed and endurance would have forced the construction of battleships and armored cruisers of deep displacements of over 16,000 and 15,000 tons and speeds of 18 and 22 knots? Who of them would have believed that within that time the resources of this country would have been so developed that when such vessels of war are to be constructed, every part going into them is of American production?"

The report enumerates some of the more important matters which have come up during the present incumbency, among which are the reconstruction of the Hartford and the proposed rehabilitation of the Constitution, the controversy by which was prevented the useless expenditure of public money for aluminum torpedo boats, the advocacy of sheathing, the Hichborn turret, efforts for the reduction of wood and the fireproofing of what remains on board ship, the encouragement of sub-

marine vessels, and the care and study devoted to conveniences for the comfort and health of both officers and men.

The estimates in the report call for $7,000,000 for preservation of and repairs to vessels of the navy, $920,000 for repairs to and improvements of Navy Yard plants and $21,772,917 on account of hulls and outfits of vessels and steam machinery heretofore authorized.

It is recommended that some vessels be built in the navy yards: "There are at the present time, in view of the prosperous condition of the shipbuilding industry and the number of naval vessels building and appropriated for, sufficient work to permit the assignment of a portion of the building work to the government yards, without there being a question of the withdrawal or withholding of necessary support and assistance, the maintenance of which in a high state of efficiency is unquestionably of national importance."

"The unanimous testimony of experience has been, and is, that the execution of a certain amount of building work in the chief government yards is necessary to the maintenance of such navy-yard staffs as a complete and efficient naval organization requires," and that England is building in her navy yards 16 battleships and cruisers, France 17, Germany 8, Russia 6, and Italy 3, in their government yards, he says:

"It is believed that we have reached that stage in naval development, still considerably behind our national development which forces upon us serious consideration of this step which other naval powers have found necessary and expedient."

Nearly 50,000,000 pounds of steel material has been inspected, passed and shipped during the year by the inspectors of the Bureau, representing an increase of more than 100 per cent. in two years. The vastness of the figures gives some idea of the extent and importance of the operations carried on under the Bureau.

The St. Lawrence Power Company's Plant.

A great power-development enterprise fairly comparable with that at Niagara Falls, is approaching completion at Massena, N. Y. Its existence is well known among engineers, though in the public press it has received but a small portion of the attention bestowed upon its forerunner. This is probably due to the fact that the Niagara Falls plant was the first of its kind, and to the further fact that the idea of "harnessing Niagara" gave a spectacular interest to that plant which no other can hope to rival.

The town of Massena lies largely between the St. Lawrence and Grasse Rivers, which at this point are nearly parallel streams—the latter emptying into the former about six miles below the town. At Masena the St. Lawrence is at about 36 feet greater elevation than the Grasse, with an intervening distance of less than three miles between them, the ground between being comparatively level and on or above the grade of the St. Lawrence, while an abrupt declivity occurs almost at the bank of the Grasse. The St. Lawrence reaches the level of the Grasse at the mouth of the latter through rapids which, for purposes of navigation, are overcome by canals and locks on the Canadian side. The scheme for the development of the power comprises a canal across the territory between the two rivers and a great power-house at the foot of the bluff already mentioned. The location is almost ideal for the purpose, and the St. Lawrence Power Company is actively at work on the enterprise.

A party of representatives of the technical press visited the works October 27 and 28, as the guests of the power company. They found a greater amount of dredging machinery at work than was probably ever gotten together before. The canal is nearly completed, and the power-house likewise—the only remaining portions of the latter being the brick filling and the roof for the steel frame superstructure which is to house the generators. The water wheels are on the ground, and a beginning has been made toward setting them. The power-house is monumental in its character. The great dam which forms its up-stream side, the division walls which divide the fore-bay into sections for the different units, the corresponding division walls in the tail-race, and the arched floors which are to support the turbines and generators form a single monolithic structure of concrete which, as such, is, so far as we know, unique.

The present development under construction is of 35,000 horse-power capacity, which is to be developed by seven units, each unit, however, comprising six turbines arranged on a common generator shaft, and in pairs to balance the thrust. Plans are drawn for twice the amount of power at present under development, and the enlargement will be proceeded with as soon as the demand for power calls for it. The possibilities of the site are almost without limit. On the present lines of improvement, the first limiting condition which will be met is the capacity of the Grasse River to carry away the water, which will be reached at about 50,000 horse-power. With dredging, this can be enlarged to a capacity of perhaps 600,000 horse-power.

Considerable importance is attached to the ultimate use of the canal for purposes of navigation as a link in the Great Lakes and St. Lawrence system. The deepening of the Grasse River and the construction of a lock between the canal and river would make Massena both a lake port and a sea port.

The magnitude of the work may be judged from the fact that the canal is 15,200 feet long, 192 feet wide at the water-line and 18 feet deep. To develop 75,000 horse-power will require enlargement of the canal to a width of 263 feet. The present power-house is a little in excess of 300 feet long. The available head of water is 32 feet. The wheels are expected to turn next summer.

Commercial Review.

NEW YORK, Friday, November 2.

THE MACHINERY MARKET.

This report is written before election to be read after that event, the disadvantages of which situation are obvious. A number of inquiries have been made this week in the engine trade and the answers go to uphold the view that prospects for future industrial activity are excellent. The spokesman for one prominent house remarks that while the larger enterprises have been in a waiting condition, trade of a small, ordinary nature has been going on freely and that business has been better than it generally is just before a Presidential election. He thinks the future has been discounted in respect to prices, which have been restrained from such declines as they otherwise would have made, and that when the resumption of industrial activity comes, values may be expected to remain about where they are rather than to advance. A boiler seller consulted states that there has been a tendency to purchase steel tubes before election in anticipation of an advance.

Another old tool-building firm has followed the fashion of going over into a stock company. The firm, Gould & Eberhardt, Newark, N. J., has taken out a charter under the same name, with $100,000 capital stock. The incorporators are: Ulrich Eberhardt, Z. Ulrich Eberhardt, Jr., Frederick L. Eberhardt and Henry E. Eberhardt.

Plans have practically been completed for the New York, New Haven & Hartford Railroad Company for an extensive car-repairing plant, to be established at Readville and Hyde Park, Mass. The company proposes to expend a half-million dollars in the installation of the shops. The various repair shops of the eastern district, which are now scattered all over the line, the principal ones being at South Boston, South Braintree and Roxbury, will be concentrated at Readville.

The largest building will be that in which truck repairing, piping, tinning, buffing, cabinet making and wood working will be carried on, the roofed area being 2¼ acres. Next comes the paint shop, covering 1½ acres, an erecting shop of the same size, a freight shop of similar dimensions, storeroom and offices, one-half acre in extent; blacksmith and machine shop, three-quarters of an acre; coal, boiler and power room, one-half acre; dry kiln, one-quarter acre, and a shed for drying hard wood, one-half acre. When the works are running at their full capacity, from 2,000 to 3,000 skilled mechanics will be employed.

The establishment in Canada of Amer-

ican enterprises, or those in which Americans are prominently concerned, is of considerable interest at present. Much has already been said about the new Dominion Iron and Steel Company. Early this year we mentioned another big project which bore it some resemblance. This was the Canadian Steel Company, with $18,000,000 capitalization, and which, it was reported, was to erect a $4,000,000 or $5,000,000 plant at Ottawa. A number of Canadians were interested, and the late E. M. Butz, of Pittsburgh, was one of its chief promoters. The Dominion Government was to grant $3 bonus for every ton of iron or steel made from Canadian ores, and the Ontario government an additional $2. Owing perhaps to the death of Mr. Butz the project has been lost sight of, but now another big one has cropped out in Pittsburgh. A company of capitalists, chiefly of that city, is said to have organized a $12,000,000 company to erect blast furnaces and steel works at Welland, Ont., operate coke ovens and mine coal in the Monongahela valley, and possibly build a new line of railroad from the coal and coke works to Lake Erie. At Welland, plentiful natural gas is available and also power from the Niagara River. Prominent among the promoters is Capt. W. S. Dent, of Pittsburgh.

A further item of news relevant to this subject is, that American capitalists have purchased the ship-repairing plant and boiler works of N. Evans & Sons, at Dartmouth, N. S., and will build a dry dock and steel-shipbuilding plant. It is said that the company has a very large capital and that extensive piers and other necessary works will be built. The company proposes to expend over $1,000,000 in the plant and will make further additions at a later date.

If any coming political event should paralyze the investment of capital in the United States, as many fear that it might, the Canadian field, close at hand, would be likely to spring into new industrial significance for us, and such enterprises as those mentioned would find many duplicates.

We hear from the Brown Gas Engine Company, of Columbus, Ohio, that business in its line is very good. Among the recent orders is one for three 50 horsepower engines for the Consumers' Carbon Company, of Lancaster, Ohio, to be installed in their factory now under construction.

The Hyatt Roller Bearing Company, Harrison, N. J., and 133 Liberty street, New York, has received an order from the Brown & Sharpe Manufacturing Company for the entire jack shafting equipment of its large new building.

The Northern Pacific Railroad Company will build new shops at Brainerd, Minn., the steel work of which will be furnished by the American Bridge Company.

Diamond Drill and Machine Company, Birdsboro, Pa., reports its drill department busy, and a good demand for its gyratory rock crushers. Since Mr. Farrell assumed the management several important improvements have been made. The new foundry, 50x150, with two 20-ft. lean-tos, is completed, its equipment including a 30-ton double trolley electric crane of 27 feet lift. The office building has been doubled in size, and a well-equipped drafting room provided. An important increase in the electric power plant has also been decided on. Indeed, the present facilities of the Diamond Drill and Machine Company will fit it better for the manufacture of the special machinery which it solicits. In addition to the staples the company builds, *i. e.*, diamond drills and rock crushers, it manufactures the Jackson belt-lacing machines, and reports a steadily maintained demand for them, not only in this country but also abroad.

Reading Wood Pulley Company, Reading, has enough work with its present facilities to keep the shop going a full twelve months. An addition to the plant is in contemplation which Mr. H. F. Glaser thinks will enable the company to handle the domestic business and allow it to accept some of the business from abroad which he has been compelled to decline owing to the heavy domestic demand.

The English Consul-General at Seoul, Corea, reports that there is a market in that country for the following classes of tools, machinery, etc.: Apparatus for exploiting gold mines, picks, shovels, rope, pumps, rock drills, agricultural implements, irrigating machines, pieces for bridges, electrical machines, telephones, telegraph and telephone wire, chemical products for the extraction of gold, candles, hardware, household utensils of enameled iron, etc.

CHICAGO MACHINERY MARKET.

October went out in a manner most becoming for the machinist supply trade. In fact the entire month was of a pleasing character. Business excelled that for September and the latter part of the month was better than the first. The Armstrong Brothers Tool Company says its tool orders in October were 15 per cent. greater than in September and that the September trade was larger than that of August. The Chicago Belting Company reports business for October this year 33 per cent. greater than for October last year and the best month's trade in its history. The Machinists' Supply Company states it can see no difference in its aggregate volume for October, as compared with previous months this year. The above statements are among the best that are heard, but they fairly typify the general report. There was dullness during the summer months, but since then business has steadily improved and is now comparable with prosperous periods.

Shop operations in the West range from fair to brisk. The situation in Chicago has quite materially improved and the sellers who cater to this local trade are enjoying a degree of activity that is wholly satisfactory. The large shops are all in operation and the smaller plants are almost equally busy. In some lines there is more than ordinary activity. Manufacturers of builders' hardware after the partial idleness of the summer months are now running overtime in many instances, the demand for product exceeding normal output. Building operations are bunched in the closing half of the season and from nails to door knobs every article used in construction is meeting with keen appreciation. Stove makers, likewise, have commenced a period of renewed activity. The mountain States are good buyers and the manufacturing plants which are becoming more and more thickly scattered among the agricultural districts of the West are calling for ever-increasing supplies, making a total that is surprisingly large.

Shop construction work is relatively less active. Here there have been felt the checking influences of the pre-election days. Builders of hangers, pulleys, shafting, etc., report moderate trade, but none of which they are especially proud. There has, however, been more buying of material for machine shops in this territory during the week immediately preceding the election than for any similar period in many months. It was induced quite largely by a firmer market and by a gaining of confidence in the prospective results of the election.

Quotations.

NEW YORK Saturday Morning,
November 3, 1900.

Iron—American Pig, tidewater delivery:—

Pennsylvania Irons.

No. 1 X foundry	$16 00 @ $16 50
No. 2 X foundry	15 00 @ 15 50
No. 2 plain	14 25 @ 14 75

Alabama Irons:

No. 1 foundry, or soft	15 00 @ 15 50
No. 2 foundry, or soft	14 25 @ 14 75
No. 3 foundry	13 25 @ 14 25

Bar Iron—Base sizes—For good refined brands on dock, 1.40c. upward, and for same from store, 1.70c. @ 1.80c., in an ordinary way.

Tool Steel—Base sizes—Good standard quality, 7 @ 8c.; extra grades, 10 @ 14c.; special grades, 16c. and upward.

Machinery Steel—Base sizes—From store, 1.60c.

Cold Rolled Steel Shafting—Base sizes—From store, 2¼ @ 2½c.

Copper—Lake Superior, ingot in carloads, 16¾ @ 17c.; electrolytic, 16½ @ 16⅝c.

Pig Tin—27¼ @ 27⅜c. for 5 and 10-ton lots, f. o. b.

Lead—For wholesale lots, 4⅜c., with .02½ @ .05c. extra for carloads.

Spelter—Prime Western, 4.20c., New York delivery.

Antimony—Cookson's, 10½ @ 10¾c.

Echoes from the Oil Country—IX.

DESIGNING AN ENGINE.

It seemed like a big undertaking when we decided to build a steam engine—a real, simon-pure engine of our own. Not a freak engine, gotten up by a wild theorist with more knowledge than wisdom, nor a copy of somebody else's engine whose ideas we admired, but a plain, common, every-day-work engine, with all of the virtues and none of the vices common to engines in general, and to those in the oil country in particular.

The faults which we had to contend with in those we repaired made us think that most of them could be improved on without much trouble, and as Mr. Smith wanted one for himself, about a 25 horse-power, we concluded to try the engine business ourselves. We had a foundry, a machine shop, and a blacksmith shop, and a shed where we did carpenter work and made patterns and flasks, and what more could we ask for?

Mr. Smith had a few ideas about the engine that he wanted, and if I worked them in he was willing that I should make the rest to suit myself. He thought an engine should be strong and durable, easy and quiet running, economical and good looking. I agreed with him in all this, and I also wanted one easy to get at for repairs and cheap to build. When we talked the matter over during a dull spell in our work, when we were casting about for something to keep our hands going, we both recognized that we needed more men when we were busy than we then had, and as our busy spells came often and men were hard to get, we must hold on to them through the dull times, some way. It seems as though most men would rather go hunting or fishing, or get sick or married, or break a leg or get drawn on the jury, when the shop is very busy than when work is slack; more sure of work when they get back, I suppose.

I was to make the drawings—after designing the engine—and, as work was needed now, I was to rush things so as to keep all hands busy. Mr. Smith suggested that I give the pattern-maker the sizes for the bed, while I figured out the more complicated parts, so as to keep him out of mischief. All day Sunday, when I should have been at church and Sunday school, I sat in the office, setting the boys a bad example and turning over the various merits of box beds and overhanging cylinders and pillow blocks cast or bolted on and with or without quarter-boxes, three and two stud glands, three-ring, Dunbar and snap-ring piston packing and other details, varying my occupation by going out and measuring some of our tools and trying to think how we would build some of the parts on them.

Now, there was the bed: if I made a box bed I would need to plane where the cylinder sat and where the guides stood, and if I made the pillow-blocks loose I would need to plane where they laid. For a 25 horse-power engine I thought I would need a 10x16-inch cylinder, and that would mean a bed about 7½ feet long, and our planer was only 24 by 24 inches by 6 feet. Of course I might set it on the planer more than once, but the engines I had been handling had a cut across the bottom as well as the top, and besides, I wanted a good wide flange on the bottom, and not one that wore into the block and got rickety the first thing, and when I got that flange outside the bed was too wide or the planer, and if it was put inside, that meant core work that would be expensive, besides being much harder to mold.

Then I thought of letting the cylinder overhang. That would shorten the bed so that it would go on the planer, and as I could babbitt the bearings I could get along without having to have them planed. The guides I determined to make solid on the bed, with bearing enough on the cross-head to make it last forever, nearly. Now, all I had to do was to figure out the end where the cylinder went and a few other details and that would settle the bed. That cylinder flange on the bed needed to be strong, because the cylinder would be heavy, and I guess I had better put a hood on it. Yes, I think a hood would be just the thing; it would stiffen things with the least weight; a nice hood about 3 inches deep around the edge of the flange would make plenty of strength, and—pshaw! I hadn't thought of that. Of course, I mind now how Billy had to tramp back from Jones's, and have them haul the entire engine in, because the nuts on the cylinder studs were back under a hood, and we worked several hours, and had three wrenches forged before we got the cylinder off, and Billy declared very forcibly that "the man that got that engine up wasn't onto his job," and I thought so, too.

But, then, I could put the hood inside of the nuts, but it would have to be heavier and longer to be strong enough, and then I have a very poor opinion of that plan since I got a wrench caught trying to tighten up a gland, and broke off a stud, and burned myself, and finally had to tear off the cylinder to drill the stud out, because I hadn't room to get in around under that hood. No, I don't think I care to make my bed that way.

Why, of course, just the thing, strange I didn't think of that before. Why can't I let it run back over the flange of the cylinder? Won't be in the way of the nuts or anything, and—Confound it, anyway, the molder will have to make that end in core, and I can hear the machinist swear already that has to turn it off with a cobbled-up device, and I don't blame him much, as my teeth get on edge, and the shivers run up and down my back, as I imagine the tool crunching and jumping and squealing through the core sand in there.

Well, I am going to dinner, and when I get back I will look over all the old engines in the yard, and pick out the one the easiest to make, and measure it up and increase the sizes to suit my cylinder and planer, and put in a few fancy lines so that no one will know it and let it go for the bed. A bed don't amount to much on an engine, anyhow. Just some iron spread out to tie the rest of it to. The cylinder and flywheels are the things, particularly the flywheel. I have several books on flywheels and will work that up in great shape. I guess I will just hold back the rest of the engine until I get the flywheel figured out and that will warm me up for the rest of the work.

That bed in the yard that looks so much like a hog trough will just suit me by making feet on it instead of on the cylinder. I have just a fine, easy rule for figuring out my sizes.

That Wood & Mann engine is a fine one. I never knew it to break anywhere from work. I will use it as a starting point for my rule. My cylinder is to be 10 inches diameter, that one is 8 inches diameter; their shaft is 3 inches, mine should be 3¾ inches diameter, as 8″ : 10″ :: 3″ : 3.75″. Don't that come out nice? Their wrist pin on the crank is 2¾ inches long; I'll make mine 3½ inches. That don't come out just even, but near enough, and I will let it go at that to keep things even. Their pillow block bearings are 6 inches long, mine to be 7½ inches. You see that rule will save me lots of trouble and time. All I need is to pick out a good engine to start with and run my sizes up by proportion. Just let's try it on the cylinders: Theirs is 8x12 inches, mine to be 10x16 inches. Theirs is 12 H. P.

$$\text{Dia.}^2 : \text{Dia.}^2 :: \text{H.P.} : \text{H.P.}$$
$$10^2 : 8^2 :: 18.75 : 12$$

and

$$\text{Lgth.} : \text{Lgth.} :: \text{H.P.} : \text{H.P.}$$
$$16 : 12 :: 25 : 18.75$$

which brings mine out just right.

Mr. Smith has been going over some of my figures and says my sizes are not large enough, that they must be increased. I asked him how the Wood & Mann engine stood it. He said that it was not a modern engine, and was not intended for over 80 pounds of steam, while ours must carry 125 pounds, so I will run over my sizes again:

80 : 125 :: $3\frac{3}{4}^2$ dia. : 4.7^2 dia. nearly. I must increase my shaft to 4¾ inches diameter, my wrist pin to 5½ inches long, my boxes to be 9¼ inches long, all according to rule, and that seems about right. Now, I must be a little careful and correct that cylinder size before going on with the rest of my calculations: 80 : 125 :: 10^2 dia. : $12\frac{1}{2}^2$ dia., which makes my 10-inch cylinder with 125 pounds of steam equivalent to a 12½-inch cylinder with 80 pounds of steam; so I will use 12½ as my cylinder size in the balance of my designing when comparing with the same engine I am now.

I had to let them have those bed sizes

in the pattern shop, and told the pattern maker he would have to use his own judgment as to some of the details, as I had not time to figure them all out (it is hard work to measure up all the sizes on a bed), and now I have lots of figures for my flywheel. It is to be 8 feet in diameter, and, according to the formulas in my books, can weigh from 900 pounds to 7,300 pounds. All I have to do is to pick the right one to use. I have consulted Unwin, Rankine and Kent, and have my head full of velocity, momentum, inertia, variation, centrifugal force and factor of safety, until I am sure I am not very sure of knowing anything very definite, except that a very heavy flywheel is harder to make run jerky than a light one, and costs more money to build.

I tried my universal formula on the flywheel. The one I measured was 54 inches in diameter and weighs 700 pounds. As mine is wanted 96 inches in diameter, it would need to be about 1,275 pounds, and, as I want this engine to run very nice, I will call it 1,500 pounds, which will make it run 200 pounds nicer than the other one.

I expect we will have some fun when we come to make this engine, and I will let you know if we do. I did not try to get my rule for designing patented. I was afraid if I searched the records I might find it not entirely new; but I can recommend it as being good, if you will use a proper starting point and lots of experience and horse sense with it. You have to do that with any of the others, and most of them are harder to work than this one.

W. OSBORNE.

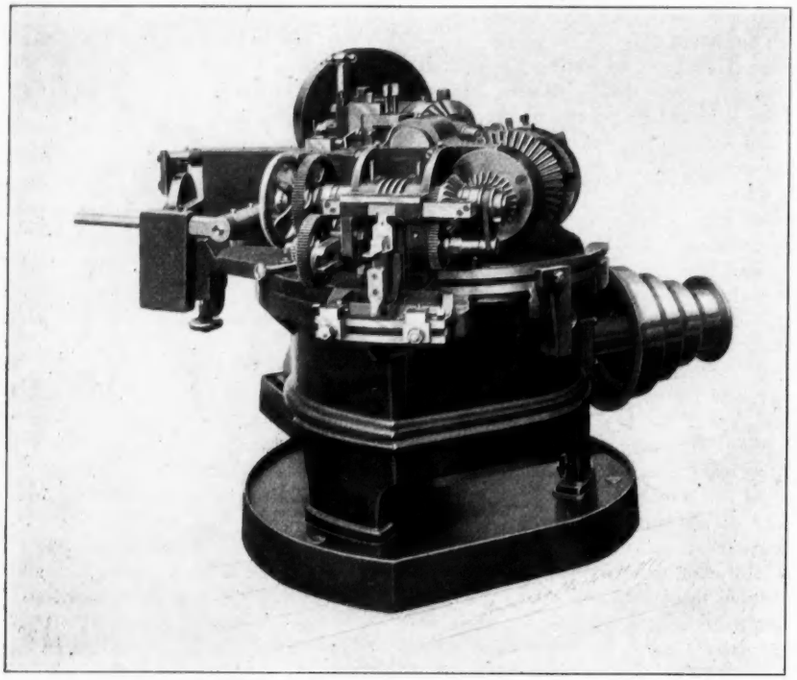

FIG. 106.

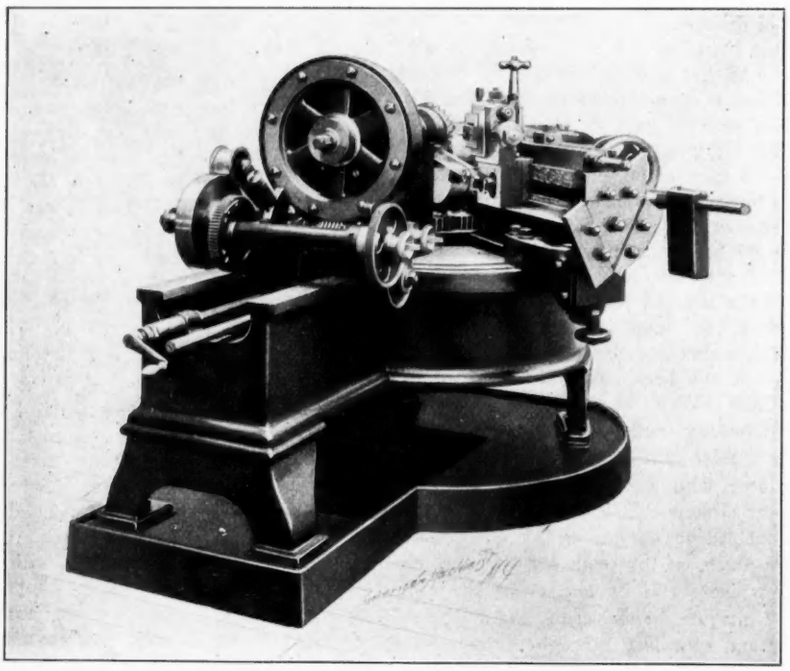

FIG. 107. BEVEL-GEAR-TOOTH PLANER SHOWN AT PARIS BY THE GLEASON TOOL COMPANY, ROCHESTER, N. Y.

The Paris Exposition—XIV.

AN AMERICAN BEVEL-GEAR PLANING MACHINE.

There yet remains one more notable bevel-gear planing machine among those shown at Paris that must be noticed and we shall then have covered the subject and I think pretty thoroughly set forth the world's attainment to the present day in the art of planing bevel-gear teeth. This last machine happens to be an American one, which, so far as its main features are concerned, has been well known in mill furnishing and other shops, where the larger sizes of bevel gears are made, for many years; but the machine exhibited at Paris is the latest and most improved form of it, and is entirely automatic in its action. It happens, too, that I am able to present drawings and a description of two new machines which have recently been built for the purpose of generating theoretically correct formers to be used in this machine. Not only are these former-generating machines very interesting in themselves, but they add to the interest of the gear-planing machine itself because they show that it does and how it does plane gears that are practically in exact conformity to what the theory of bevel gears demands. The generating machines are not shown in Paris, and in fact have been completed so recently that they could not have been shown there; but, nevertheless, they are a part of the subject and really stand behind the machine itself and its work in such an important relation as to make their presentation in connection with it not only justifiable but necessary in order to understand the gear-planing machine itself. They show how an objection that has been brought against all template gear planing machines on the ground of the necessarily inaccurate character of the templates or formers has by this company at least been overcome. This gear planer and the template generating machines are the product of the Gleason Tool Company, of Rochester, N. Y.

The bevel-gear planing machine itself is shown in the photographs, Figs. 106 and 107, where it will be seen that the machine consists principally of a head for the work-carrying spindle or arbor which last is horizontal and the head itself can be moved back and forth upon the bed to

accommodate gears of various proportions or those having hubs of unusual length. There is also a clear space in front of the blank so that where a hub happens to extend beyond the apex of the gear itself the machine is still able to handle such a gear. On the spindle that holds the work there is the usual master wheel by which the divisions are made and this is turned automatically at the proper times by a friction-driven indexing mechanism in the usual manner. On the bed of the machine rests a plate or saddle which is pivoted to swing in a horizontal plane about a center over which the apex of the pitch cone of the gear to be cut is placed by adjustment to position and the feed motion swings this plate inwards about this center to the required tooth depth. The feed being continuous excepting when the tool is at the full depth of the tooth when it pauses for an extra stroke before returning. A tool-carrying head reciprocates upon a slide mounted upon the saddle referred to and is moved by a crank and connection best seen in Fig. 107. This slide not only has the swinging motion in a horizontal plane given to it by the feed motion already referred to, but it also swings in a vertical plane about a center which intersects the other center lines and this vertical swinging motion is controlled by the former in the manner shown clearly in both photographs; a roller, attached to the arm, resting on top of the former. A former is required for each side of the tooth of the gear and both these, together with a straight former, which is used in "stocking out" gears from the solid blanks are mounted upon a plate of triangular form, as seen in Fig. 107, and which is pivoted at its center so that the required former can be brought into correct position very readily. The other mechanism is for automatically returning the tool to the top of a tooth space at a rapid rate, indexing the blank and again starting the feed motion, all of which goes on without attention until the wheel is finished and the machine automatically stops itself. These machines are of course built in a variety of sizes, but the one shown is called the 24-inch machine and is for planing gears as coarse as 1½ diametral pitch in cast iron, or 2 diametral pitch in steel; although it is best adapted to gears of 4 diametral pitch in both cast iron and steel. By the use of the regular formers for the gear teeth, it will plane pairs of gears with ratios up to 1:8 and with special formers to any required ratio; its range of angle not being limited between 0 and 90 degrees. A notable feature of the machine is its stiffness and apparently heavy proportions in all parts considering the character of the cuts it is expected to take and this is considered to be important in order that the results provided for in the theory of the machine may be as nearly as possible actually realized in the gears cut by it.

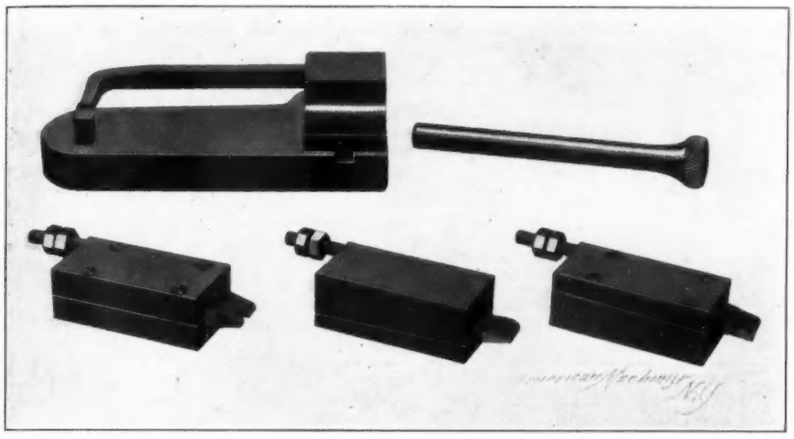

FIG. 108. GAGE AND TOOLS USED WITH THE GLEASON BEVEL-GEAR-TOOTH PLANER.

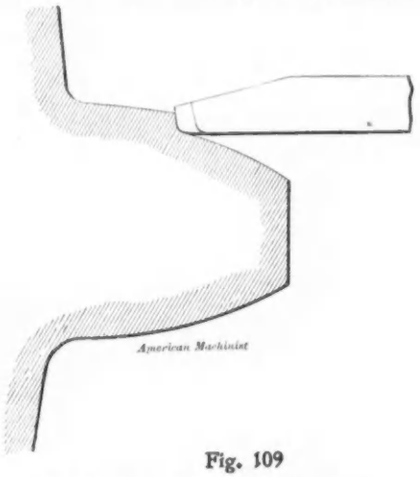

Fig. 109

THE PLANING TOOL AND THE CUT.

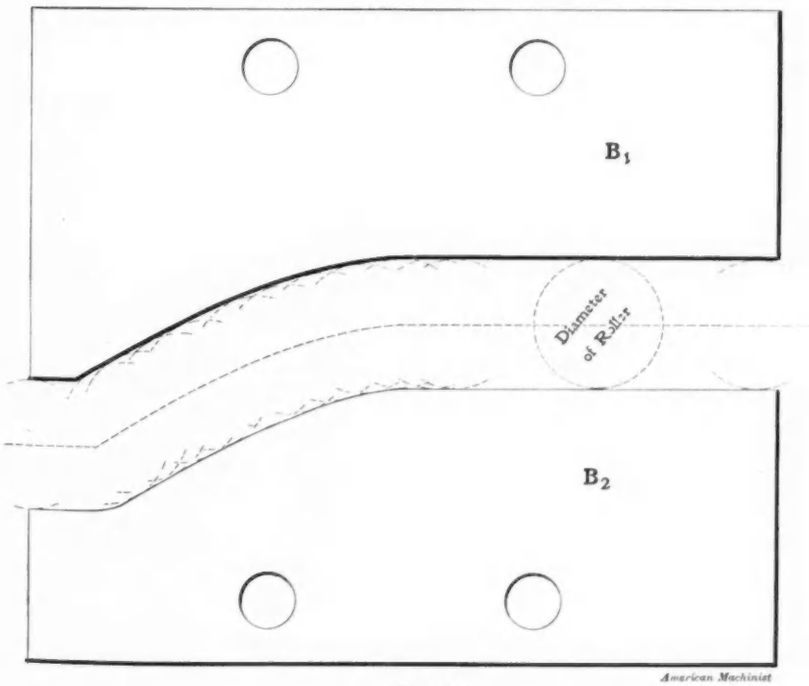

Fig. 110

SHOWING CURVES OF TOOTH-TEMPLETS MODIFIED BY ROLLER.

Fig. 108 shows a group of tools used in connection with the machine. These consist of a gage for setting the tools in the machine at the proper hight and three different planing tools; the one at the left being a double-faced tool for blocking out blanks from the solid and which is fed straight into its cut by the straight former seen in Fig. 107, while the other two are for the two sides of the tooth space, the cut with these being taken as shown at Fig. 109 by the end of the tool, the corner of which is rounded to the radius of the clearance curve at the bottom of the tooth.

The generally accepted way of following a former is to have the knife-edge rider bear upon it, in which case the former is of course an exact enlarged outline of the tooth. By the use of a roller the life of the formers is preserved indefinitely, but when a roller is used the formers are not an exact enlarged outline of the tooth curve, as may be seen in Fig. 110,

where the path the center of the roller describes is the true curve but the formers are a corrected curve generated by the cylindrical surface of the roller.

MACHINE FOR GENERATING TOOTH-FORMERS FOR PLANING THE BEVEL PINION GEAR-TEETH.

Figs. 111, 112, 113 and 114 show a machine designed by the Gleason Tool Company for making these formers. Fig. 112 is a side elevation of the machine showing the formers $B1$ and $B2$ in position to be acted upon by the milling cutter $E6$. The formers $B2$ and $B1$ are for the top and bottom side of the tooth respectively, and they occupy a position in this former generating machine the same distance from the center O of the machine that they afterward occupy in the gear-planing machine. The cylindrical milling cutter is the same diameter as the guide roller on the end of the arm of the gear-planing machine, and it occupies the same relative position in the former-generating machine that the roller does in the gear planer. This mill is driven from the belt cone by means of the shafts and bevel gears as can be easily followed in the drawings, the short vertical shaft $E3$ passing up through the center of the machine about which all the principal motions take place.

The part E, Figs. 111, 112 and 113, turns in a horizontal plane about the center of the machine. The overhead arm A turns in a vertical plane about the center O, while at the same time it of course has the same motion in a horizontal plane as has arm A, the motions of this bar being in fact identical with the motions of the bar or slide

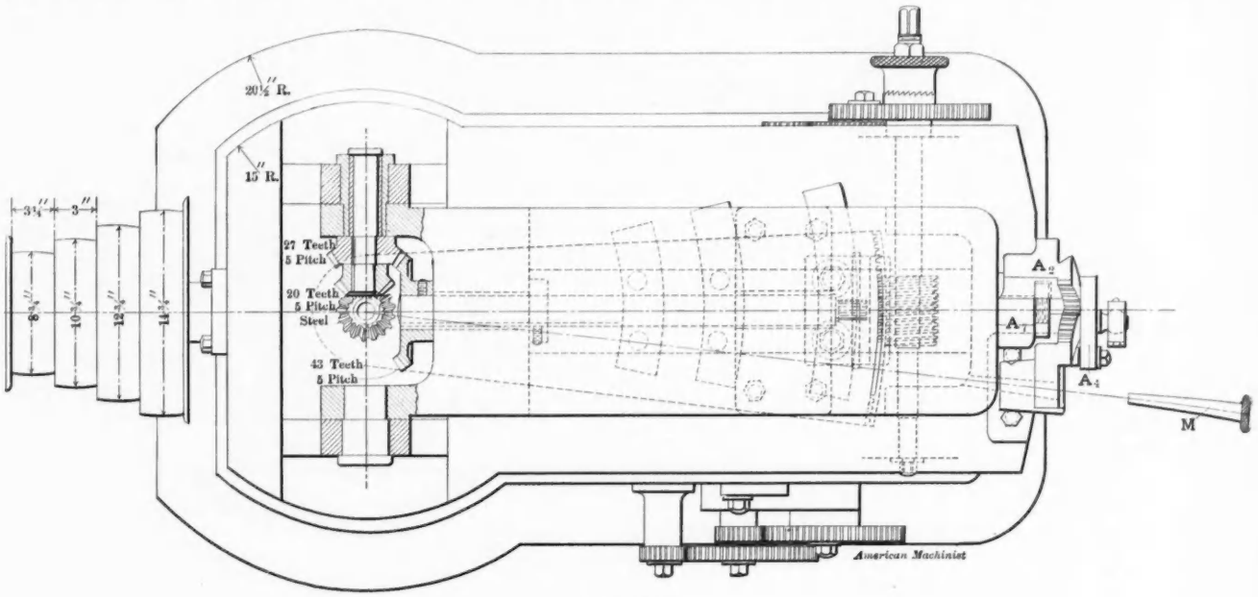

Fig. 111

PLAN AND PARTIAL SECTION OF GLEASON MACHINE FOR GENERATING BEVEL-PINION TOOTH-TEMPLETS.

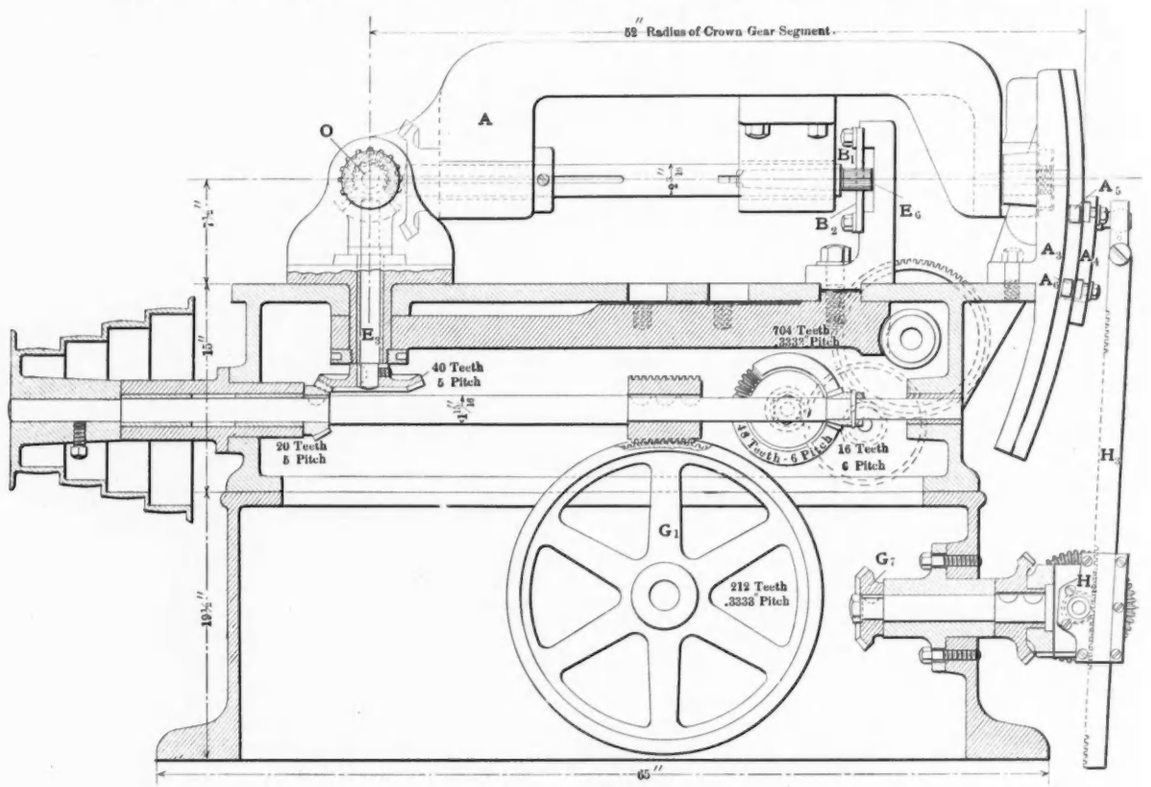

Fig. 112

SIDE ELEVATION AND PARTIAL SECTION OF GLEASON MACHINE FOR GENERATING BEVEL-PINION TOOTH-TEMPLETS.

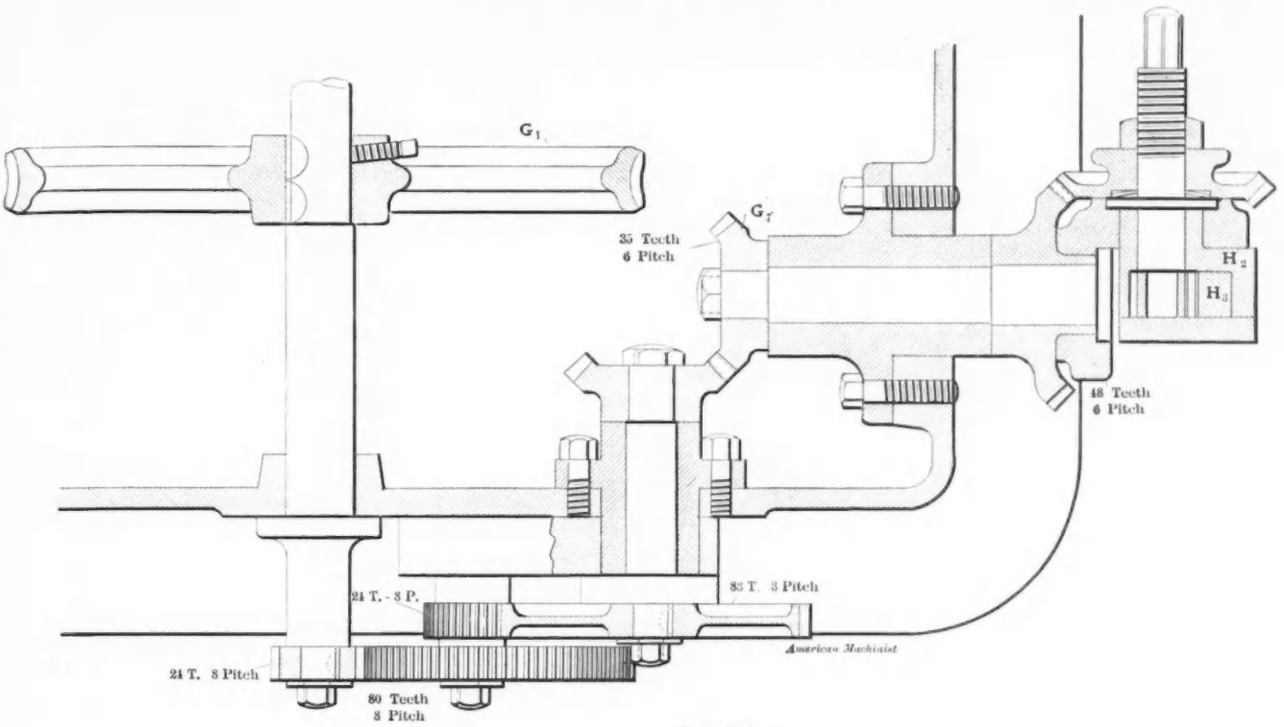

Fig. 114

FEED MECHANISM OF GLEASON TEMPLET GENERATING MACHINE.

that carries the cutting tool in the gear planer.

On the end of bar *A* is turned a trunnion *A7*, Fig. 111, the center line of this trunnion being a continuation of the center line of the milling cutter, which also passes through the center *O* of the machine. On this trunnion is fitted, to rotate freely, the segment of a crown gear, *A2*, Figs. 111 and 113, the center line of the trunnion *A7* passing tangent to the pitch surface of the crown gear.

A3, Figs. 112 and 113, is a segment of a bevel gear bolted fast to the frame of the machine. With this segment of a bevel gear the crown-gear segment engages, the two being held together by means of a slide *A4*, which passes around the back of each. This slide *A4* is moved from one end to the other end of the stationary segment *A3*, thus causing the crown gear *A2* to revolve around the segment of the bevel gear. A pair of rollers, *A5* and *A6*, Fig. 112, are fastened to the slide and act as gibs to hold it in its place. They roll on a conical surface on the back of segment *A3*, which surface is turned in the lathe radial with the cone center of the segment gear. The surface back of the crown gear is turned at a sharp angle so that the slide will hold to its place.

The crown gear being fastened to and rotating on a trunnion turned on the end of the bar *A*, it will readily be seen that the center of the cylindrical milling cutter will describe a true spherical involute when the slide travels up the backs of the two segments and thus rotates the crown gear around the stationary bevel-gear segment. The pitch line of the bevel-gear segment is the base line on which the pitch line of the crown gear rolls. The Gleason Tool Company use a 14½-degree involute on their standard formers, and the radius of the bevel-gear segment is made to correspond.

When the crown gear has rolled a sufficient distance around the bevel-gear segment, to allow the milling cutter to complete the spherical involute curve, then a taper pin *M*, Fig. 111, is inserted, which binds the radial bar *A* fast to the stationary segment. Then the axis of the milling cutter is in a position tangent to the pitch cone of the generating circle and an auxiliary feed is thrown in which mills off the straight part of the form below the curve,

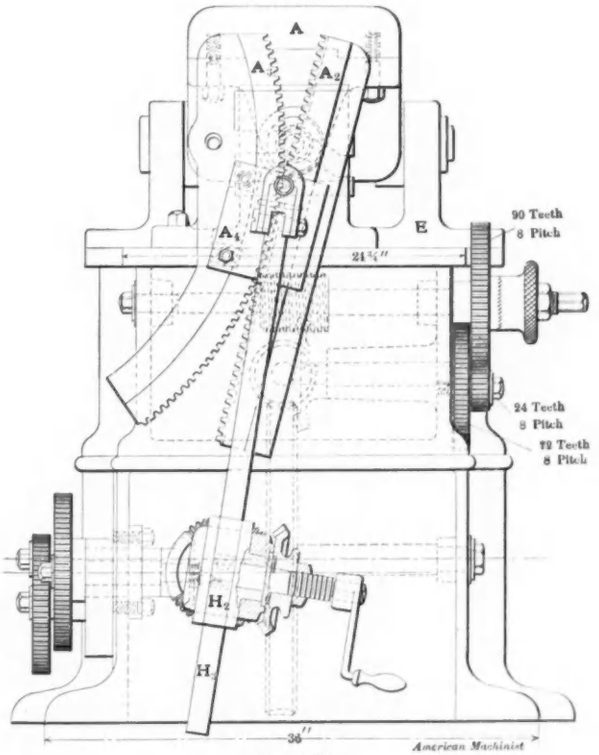

Fig. 113

END ELEVATION OF GLEASON TOOTH-TEMPLET GENERATING MACHINE.

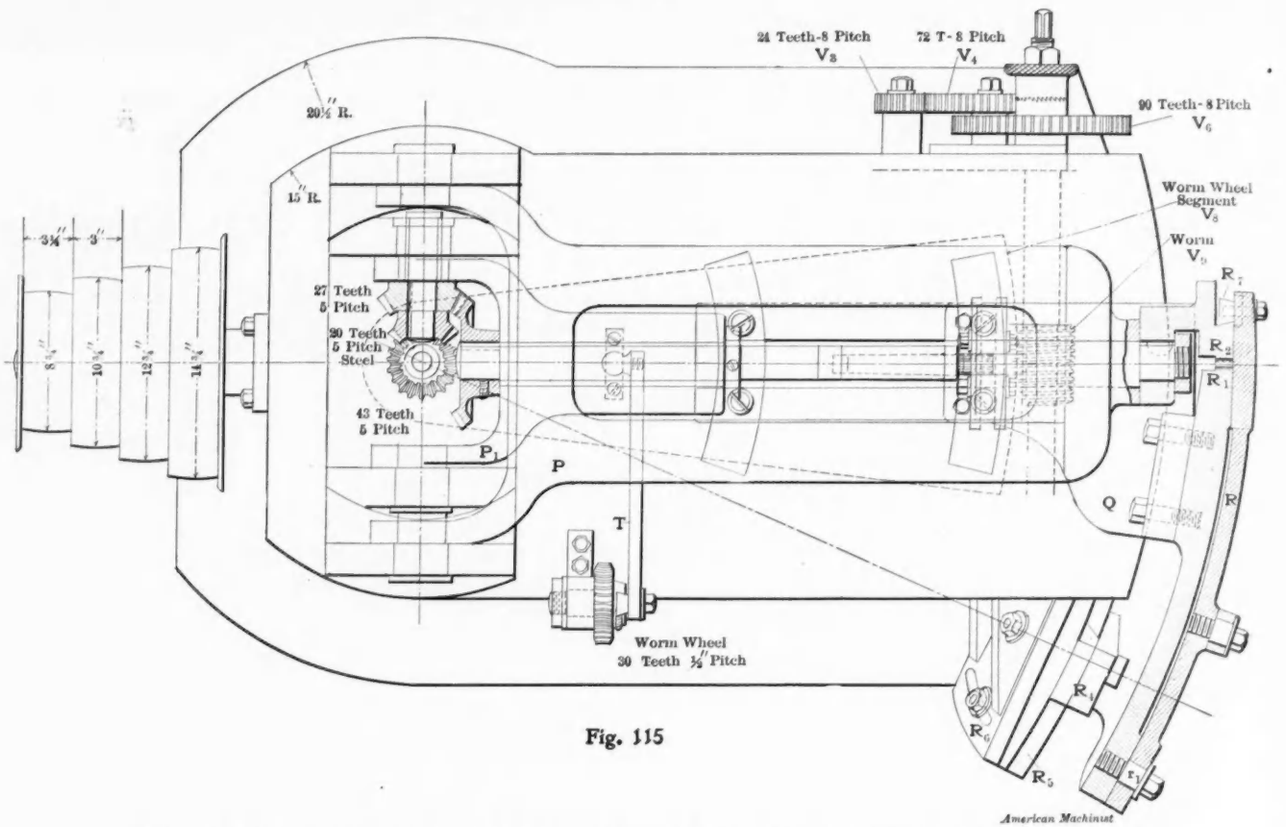

Fig. 115

PLAN AND PARTIAL SECTION OF GLEASON MACHINE FOR GENERATING TOOTH-TEMPLETS FOR BEVEL-GEAR WHEELS.

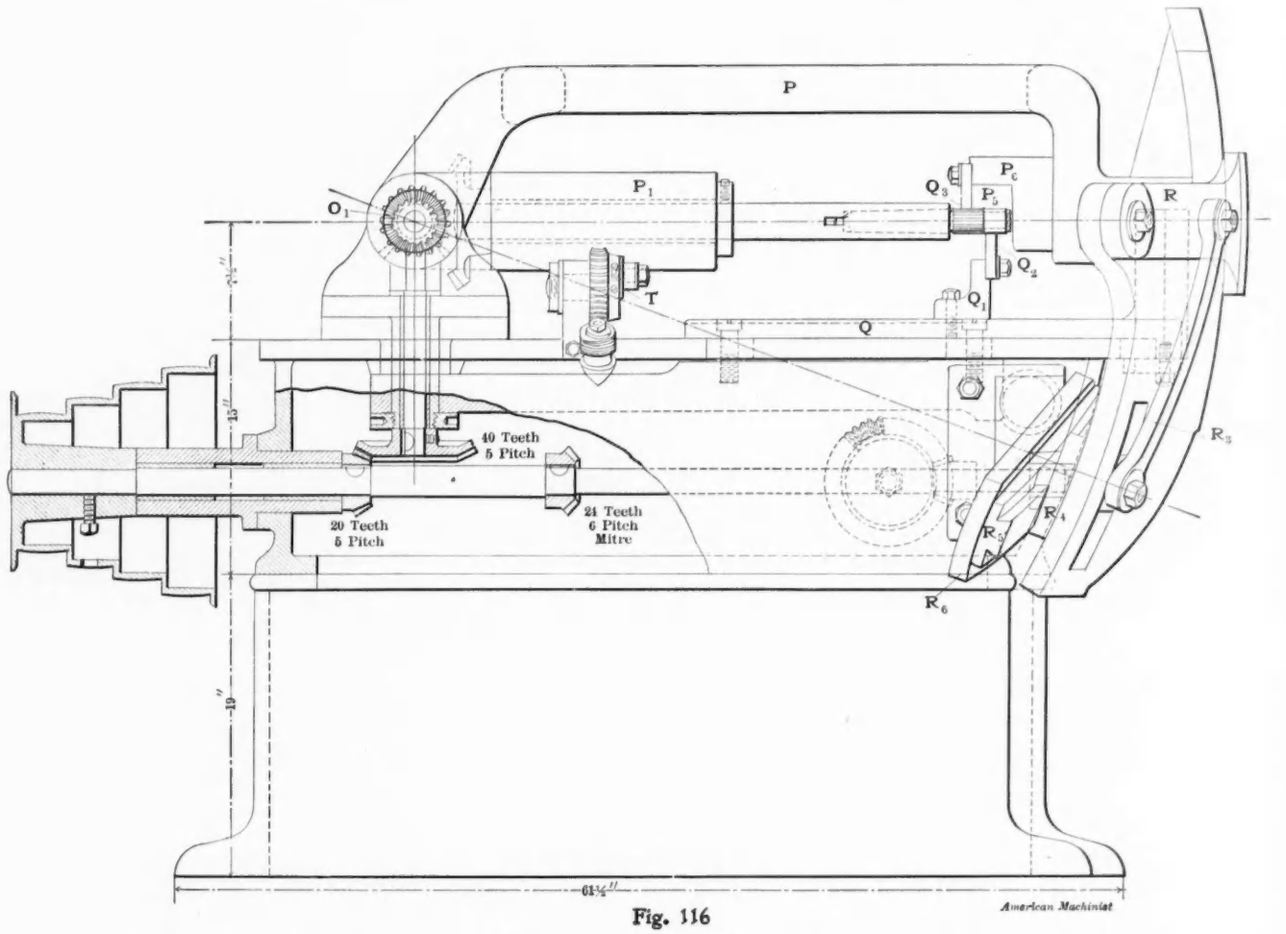

Fig. 116

SIDE ELEVATION AND PARTIAL SECTION OF GLEASON GENERATING MACHINE FOR BEVEL-WHEEL TOOTH TEMPLETS.

as seen in Fig. 110. When this auxiliary feed is thrown in the formers feed past the mill in a horizontal plane, the mill rotating in a fixed position.

Of course, it is necessary to have a series of bevel-gear segments in order to make a complete list of formers for all angles.

The feed works are shown at Fig. 114, and will be readily understandable from it.

MACHINE FOR GENERATING THE FORMERS FOR PLANING THE GEAR TEETH.

If both the gear former and the pinion former were made by the process just described, the result would be a great deal of interference between the flank of the pinion tooth and the face of the gear tooth. For this reason the pinion former only is made in the machine described, and then, using this pinion former as a pattern, it is placed in another machine, as shown at Figs. 115, 116 and 117. The former that has been made for the pinion is shown at *Q2*, Fig. 116, and the construction is such that the former for the mating gear is rolled around the pinion former, but with a milling cutter (representing the guide roller) between them, or rather so that it rests upon the pinion former and mills the gear former.

The figures show how a radial arm, *P1*, carries the cutter spindle and milling cutter. At the extreme end of the mill is a free turning roller, which rests on the pinion template, as shown.

The radial arm *P1*, Figs. 115 and 116, has a short oscillating motion imparted to it through the connecting rod *T*, Figs. 115 and 116, in which motion the roller *P5* follows the curve of the pinion former. The radial bar or arm *P* has two motions, one in a horizontal plane and one in a vertical plane about the center *O*, and its outer end is bored out in line with this center. In this bored hole in the end of the bar there is fitted, to rotate freely, a casting, *P6*, Fig. 116, and the inner end of this casting carries the gear tooth former (*Q3*) to be milled. To the outer end of this casting *P6* is keyed a segment of a bevel gear *R2*, Figs. 115 and 117. The pitch line angle of this bevel-gear segment must be the same as pitch line angle of the gear for which the former to be milled is intended.

The pattern former *Q2*, Fig. 116, is fed in a horizontal plane around the center *O*. As seen in Fig. 116, the casting *Q*, which carries the pattern former and former holder, is bolted to a worm-wheel segment which segment is made to rotate around the center of the machine in a horizontal plane.

The former holder *Q1* is bolted to the casting *Q*, and at the outer end of casting *Q* is bolted fast a bevel-gear segment *R1*, Figs. 115 and 117. The bevel-gear segment *R2*, rotates on the end of the radial bar *P*, meshes with the bevel-gear segment *R1*, which has the same pitch line angle as the pinion for which the pattern former *Q2* is intended. At the center *r1* of the bevel-gear segment *R1* an arm is pivoted. This arm passes around the back of the bevel-gear segment *R2* and by means of the conical rollers *R7*, Fig. 115, serves to hold the bevel-gear segment *R2* in mesh with segment *R1*.

Bolted to the frame of the machine is a plate *R6*, and to this plate is bolted a circular slide *R5*, on which moves the circular sliding block *R4*. The working surfaces of these slides are all turned in the lathe so that the slide *R4*, when it travels, moves in the arc of a circle the center of which intersects the main center of the machine, or, in other words, its path may be said to be along the element of a sphere having its center at *O1*.

The slide *R4* is connected to the arm *R* by the connecting rod *R3* and a rectangular sliding block constrained to move in a vertical arc of a circle, as shown in Figs. 116 and 117, the center of this last-mentioned arc being also at *O1*.

The operation of the machine is as follows: The plate *Q* carrying the pattern former is fed in a horizontal plane around the center of the machine. The slide *R5* is inclined to the horizontal plane and held stationary so that when the casting *Q*, which carries the bevel-gear segments, advances, the arm *R* is turned about its center by the connections, as shown. This causes the bevel-gear segment *R2*, which is attached to casting *P6*, which in turn carries the former to be milled, to rotate around the segment *R1*.

The radial arm *P1*, which carries the milling cutter, has two rotary motions at the center *O1* of the machine, one vertical and one horizontal, its vertical motion being independent of the vertical motion of the radial bar *P*, so that the milling cutter is free to follow the curve of the pattern or pinion-tooth former, while both the cutter and arm *P* have the same horizontal motion.

The short oscillating motion of the cutter is necessary in order that the cutting mill will fully cover the point of contact between the two curves. This point of contact does not travel at a regular rate, but when the two formers are rolled together as described, its path is fully covered by the short oscillating motion of the mill.

While most of those who see the bevel-gear planing machine at Paris will probably not suspect it, yet it is apparent, I think, from the foregoing, that there is very much behind the machine that is exceedingly interesting and instructive.

F. J. M.

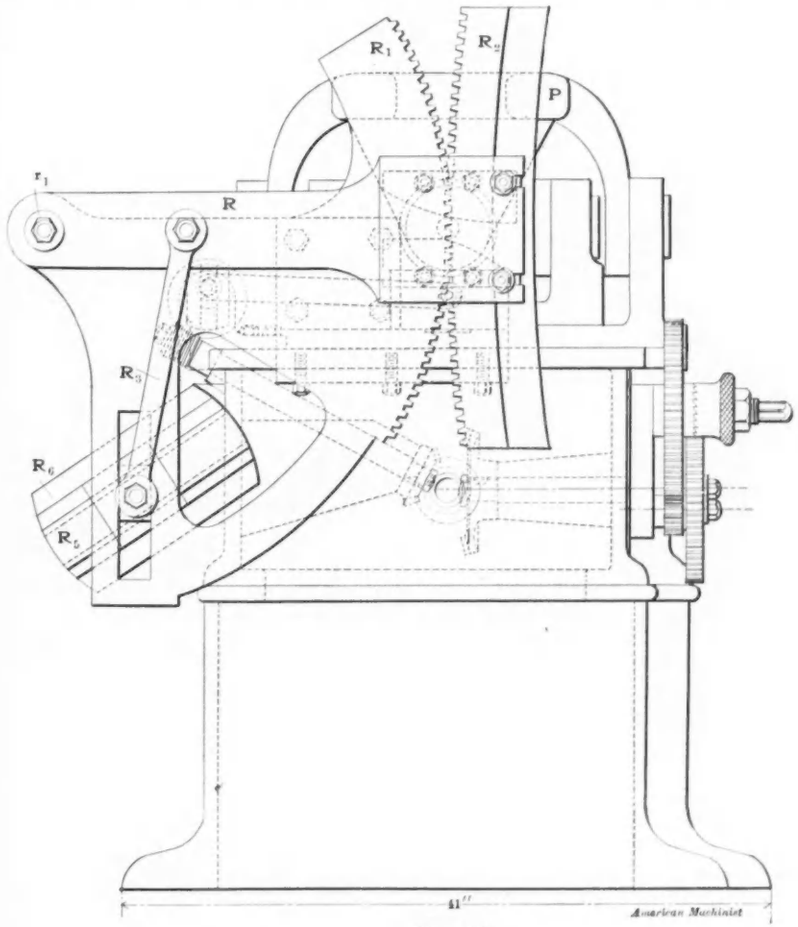

Fig. 117

END ELEVATION OF GLEASON TEMPLET GENERATING MACHINE.

An exploring party on the steamship "Corwin" has discovered an immense field of semi-bituminous coal near Cape Sabine on the Arctic coast of Alaska.

Cost Keeping at the Chicago Works of Fraser & Chalmers—II.

ORDERING WORK.

After the drawings are finished they are taken by the order clerk, who writes duplicate order cards for each piece on the job. These order cards are printed forms on light-weight bristol board, and in form and size are as per Fig. 1. White cards are used for cast iron, blue cards for wrought iron and steel, yellow cards for bronze, brass and composition metal, and forgings. The original cards are sent into the shops with the drawings, and the duplicates go to the cost department, where they are placed in the drawer in proper order with other cards of the same job.

The original card goes to the first department having work on the piece called for. This department having completed its work on the piece, the date of completion is entered in the proper column, and the card and piece of work go to the next department having work to do quired, a typewritten "Lists of parts," shown in Fig. 3. A copy of this list is sent to each department having work to perform on the parts called for. In the columns provided for the purpose the department clerk endorses on the lists, opposite the name of the part, the date the work is completed at the same time the endorsement is made on the order card. This list is kept in the department as a check upon all pieces, so that in case a piece is lost, it can be easily traced back and shown between what departments the

ORDER No. _____ DRAWING No. _____ SYMBOL _____

DESCRIPTION: _____

MATERIAL _____ TOTAL WT. _____

Date Ordered		Quantity	Date Complete
	Forge Dep't. Make		
	Machine Shop Finish		
	Stock Room Furnish		

REMARKS:—

Fig. 1

ORDER CARD FOR FORGINGS—ACTUAL SIZE, 3X5 INCHES.

ORDER No. _____ DRAWING No. _____ SYMBOL _____

DESCRIPTION: _____

MATERIAL _____ TOTAL WT. _____

Date Ordered		Quantity	Date Complete
	Pattern Shop Make		
	Foundry Make		
	Machine Shop Finish		

REMARKS:—

Fig. 2

American Machinist

ORDER CARD FOR CASTINGS—ACTUAL SIZE, 3X5 INCHES.

ORDER NO. _____

NAME OF JOB: _____

DATE TO BE SHIPPED _____

	No. Pieces Wanted	DESCRIPTION	Patt. Shop.		Foundry		Machine Shop				REMARKS
			Ord.	Comp.	Ord.	Comp.	Ord.	Comp.	Ord.	Comp.	

Fig. 3

American Machinist

LIST OF PARTS.

red cards for steel castings. Other colors of cards may be added to indicate other metals or materials used. This facilitates the picking out of parts wanted, as it is usually known what material the piece wanted is to be made of. The cards are padded and duplicate copies are made with carbon paper. The form shown in Fig. 1 may be altered to suit the requirements of the shops using the system by changing the names of the departments on the card, by substituting other names, or by leaving off some and adding others, as shown in Fig. 2, which is suited to castings—the form shown in Fig. 1 being intended for

on it. The department supplying the material called for endorses in the proper place on the card the weight or quantity of the material. The same method of procedure is followed for every piece, and finally all cards find their way to the department in which the job is finished. As soon as the job is completed, the last department having work thereon forwards all cards to the cost department, writing upon the cards the date work was completed on each piece. This should be done as each piece is finished. When the cards are first made out, the order clerk makes in duplicate, or as many copies as are re-

piece was lost. This is a very necessary feature in a large works, as it settles the disputes that so often come up concerning such matters between the heads of the departments.

One card and one item on the list orders all parts on one member* of a job that are alike. For example, there will be one order card and duplicate and one item on the list of parts for an engine cylinder and each of its parts, as follows:

*By "member" is meant a collection of pieces which act together; as a connecting-rod is one member, a cross-head is another, a pillow-block another, etc.

1st Card—	1	Engine cylinder.
2d Card—	2	" legs.
3d Card—	8	" " cap screws, 1x3".
4th Card—	2	" heads.
5th Card—	1	" " false cover.
6th Card—	48	" " studs and nuts, 7/8x4½", etc., etc.

All items are carried out as shown and are placed on the list in the relation they have to each other, the parts of the job being classified, as cylinder and all its parts, engine frame and all its parts, flywheel and all its parts, etc.; all complete members of the job being thus segregated and listed complete with their parts.

When pieces such as cap screws, bolts, etc., are alike on several members, as they are liable to be, the quantity required for each member is ordered on a separate card, that they may be more easily classed with the member to which they belong. When pieces are alike, but right and left hand, they are usually ordered on the same card. With the above arrangement of the list, it is easy to find any small member on the list by the relation it bears to the principal part.

PROGRESS THROUGH SHOP.

Returning to the time the order cards entered the shop, the job is taken to the workman by the foreman, who hands him the card and drawing calling for the piece to be worked upon. At the same time he hands him a time slip which has proper data upon it, as shown in Fig. 4. When the work is completed, the workman returns both card and drawing and endorses on the time slip his own name or number and the number of hours consumed on the work, and drops the slip into a box provided for the purpose. Each time slip bears but one job, and if the job is carried over from day to day, one time slip must be put in for each day's work.

The following morning all time slips for each department are taken by the time clerk of that department and are properly sorted out, according to the workman's name or number, and the time shown on all slips handed in by each workman, be it one slip or twenty, must balance with the time credited him by his check or in the time book or clock. The department clerk computes the value of the time credited him on each slip and places thereon the amount of wages paid for the work. The time slips are then re-sorted, according to order numbers and are sent to the cost department, where they are filed in the drawer behind the duplicate order card referring to the same piece on each job.

The time slip should be about 1/8 inch less in size than the order cards for convenience in handling in the drawers. They are printed on common newspaper, and when ordered in lots of 500,000 at a time, can be purchased for less than 25 cents per thousand. They should be properly headed for the department in which they are used and bound in tablet form.

The stock requisition slips are of the same size as the time slips, and are shown in Fig. 5. They are sent to the cost department each day and placed in the drawer behind the duplicate cards calling for the piece to which they belong.

MACHINE SHOP TIME SLIP Date

Order No. _____ Draw. No. _____ Symbol _____

No. Hours	Description	

Workman _____ Foreman _____

Fig. 4

WORKMAN'S TIME TICKET—ACTUAL SIZE, 2 7/8X4 7/8 INCHES.

STOCK REQUISITION

Order No. _____ Date Del. _____

Material: _____

Quantity: _____

Use: _____

Workman given to _____

Stock Clerk.

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Fig. 5

REQUISITION SLIP—ACTUAL SIZE, 2 7/8X4 7/8 INCHES.

This method of operating is used in all departments until the job is completed and the order cards have been sent to the cost department.

All "replace time," *i. e.*, time used to replace that put in on work spoiled or lost, should be noted on the time slips recording time so spent, marking the slips "replace time." Cards ordering material to be replaced should be made out in duplicate in the department ordering the replace, one of these cards to be sent immediately to the cost department, at the same time forwarding to the cost department the original order card if the work to be replaced was finished. If the original work was not completed, the original card must be held and as soon as the replace work and material are finished, the replace card is sent to the cost department. The replace cards should be written in, say, red ink, that they may be more easily distinguished as "replace."

The above precaution is taken concerning replace work that it may not be charged into the cost account, but be figured in as "Replace Work" and "Material," so as to avoid an erroneous cost account by losing sight of spoiled work.

The job being completed and all cards turned in, the original order card is placed with the duplicate order card and the complete bunch of time slips previously filed for each piece, and the cards are taken out of the case by a clerk, who computes and places on the back of the duplicate order card the value of all material called for, all time consumed in each department separately, adding to each amount the burden for that department. The whole column is then footed up.

WRITING UP COST SHEETS.

After the entire job is completed in this manner, the cards and slips are handed to the clerk, whose duty it is to write up the costs. This is done on sheets properly ruled and provided for the purpose, as shown in Fig. 6. When these sheets are written up, properly segregated, footed up as segregated and total footings made, they are bound in a tough paper cover, properly marked and indexed ready to file away. The object in view in segregating the job and making the described footings is to facilitate future estimating. With one of these sheets having the parts properly segregated, one will readily see how easy it is to make a complete estimate on some special engine never before built, by taking the cylinder complete or with such parts as desired from one job, the frame and parts desired from another, the flywheel and parts from a third, etc., until the estimate is complete. Erection of the job is kept separate, and this may be placed in the estimate at the cost of the nearest similar job, or at an average between two others.

The estimate made in this manner from these cost sheets, while an estimate on some machine never actually built, is based on such accurate data from the costs of like parts on other machines that the factor of speculation or guesswork is prac-

tically eliminated, except in the matter of erection.

The form shown in Fig. 6 should be kept in design about as shown, except as changes are desirable to suit special requirements. Columns similar to the one headed Molder should be added in proper order for Core Making, Cleaning Castings, Forge Department, Pattern Shop, Machine Shop, etc., there being one column for each department.

FOUNDRY IRON ACCOUNT.

It is customary in most foundries to determine a price per pound on the different classes of castings, sometimes classifying them also as to weight. Under this method practically no account is taken of the varying amount of the time consumed in molding the casting and little is known about the time taken for core making and cleaning. Some charge per pound of iron is also arbitrarily taken, disregarding the amount of labor of charging and tapping the cupola.

The amount of time consumed in charging and tapping the cupola and the cost of coke used in melting rightfully belong to the cost of iron ready to pour into the mold. The iron account is made up of the cost of the iron used at the price paid for the various kinds, taking the price per pound based on the value of the mixtures for each month. One price per pound for iron used for castings will answer every purpose, as it would be too complicated and entail too much figuring to charge castings having higher priced iron than others with the higher rate. Also add to the Iron Account the cost of coke and of charging and tapping cupola, all repairs and cost of furnishing blast. All salvage returned and used in the cupola should be charged in the iron account at the value found by the previous iron account. This avoids determining the price of each day's salvage and charging it on the daily cupola report when it is used.

Assume that we have two castings of exactly the same size in general dimensions and design, excepting that one, on account of having thinner metal than the other, weighs but half as much. It is obvious that the foundry work on the thinner casting will be as much if not more than that required on the thicker one, showing plainly the necessity of keeping the account of foundry hours on each piece and the fallacy of having a uniform price per pound to charge for castings.

The system described is equally adaptable to other branches of the manufacturing business, where detailed costs are required, as to the machinery business. If organized and operated along the lines described and handled by a person of ordinary intelligence and some common sense, it may be enlarged upon and carried into further detail, admitting of most minute comparisons of costs of work. It would entail too much writing and the use of too much space to do that here.

It is advantageous to have sheets for recapitulations of jobs properly ruled, upon which to enter the recapitulation of the general figures of the cost sheet. These may be kept classified and bring the chief accountant closer in touch with general figures, permitting general comparisons of costs of the same work at different times.

Minute details of the costs of varieties of castings, machine shop or pattern work may be kept classified on sheets similar to those shown in Fig. 6, changing the column headings if necessary. It would be advisable to keep such a classified comparison sheet for all parts involving large amounts of time, as it will be found to assist very materially in finding and running down wasted time. In the data entered on such sheets as this the burden should be left out, to allow an easier comparison of the wages paid as well as of the hours consumed. The dates upon which the work was done or completed should also be kept on these sheets.

The time slips and order cards of complete jobs may be tied up in a bundle, keeping them in proper order, and stored away for future reference. This is not necessary, but may be done as a precaution, and the slips are sometimes useful to find out what men executed the work.

The writer is a firm believer in making records within the bounds of reason, and when they are made, preserving them. It costs something to make them, but nothing to keep them.

Margin For Binding 1¼" Wide

ORDER No: _____ FILE No: _____

DESCRIPTION: _____

	No. Pcs	Name of Part	Draw. No.	Symbol	Material	Weight.	Cost Per. lb.	Total Cost Material	Moulder Time	Moulder Amount	Total Cost	Replace	REMARKS

Fig. 6

COST SHEET.

American Machinist

The Application of Sweet's Diagram to the Meyer Valve.

BY J. BEGTRUP.

Fig. 1 shows the Meyer cut-off, which has been in use since 1842. Adjustable slides work on the back of the main valve, and are driven by a separate fixed eccentric. The slides are shown close together, which is the adjustment for latest cut-off. *A* and *B* are cut-off edges, and the distance they are apart constitutes negative lap, which is called "space." By turning the screw the slides are separated and the space is diminished, which has the same effect as increasing the lap on other valves, that is, it brings about an earlier cut-off. The stem of the screw extends through the back of the steam chest and it may be turned without stopping the engine, by means of a hand wheel mounted on a sleeve. The main valve has an extension on each end, which contains the passage through which the steam is conveyed to the main cylinder-port; otherwise the face of the valve is constructed as that of a common slide-valve, designed to cut-off at about three-quarters of the piston stroke.

FUNDAMENTAL PRINCIPLES.

In order to fully understand the working of separate cut-off valves, certain fundamental principles should be well understood. First, it should be recognized that the action of the cut-off valve depends entirely on its motion *relative to the main valve,* and if this relative motion can be represented abstractly in a simple manner, any reference to the motion of the main valve will be useless.

In Fig. 2, *B* is the center of the main eccentric, and *E* is the center of the cut-

off eccentric, and these centers are connected by an imaginary straight line. The two points B and E form a connected system of points, which moves around the center A and at the same time the system revolves about itself or about some point in the system, thus: point B describes a circle around point A, and at the same time point E describes a circle around point B. Four positions of points B and E are shown by full lines, and dotted lines indicate the positions E would take if it did not revolve about B, in which case the cut-off valve would evidently not slide on the main valve at all, and there would be no cut-off action. This action, therefore, depends on the rotation of E around B, and is not in the least affected by motion of B about A, and the relative motion of the cut-off valve will be as if it worked on a stationary seat and were

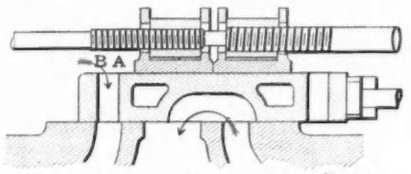


Fig. 1 American Machinist

THE MEYER VALVE.

driven by an eccentric of eccentricity equal to distance $B\,E$. The upper circle, Fig. 2, represents the path of this equivalent cut-off eccentric, and corresponding and coincident positions of the eccentrics in both figures are indicated by the notation. Note that *corresponding positions of the cut-off eccentric-arm, from B as a center of rotation in both figures, are parallel.* When the equivalent eccentric is at mid-throw the cut-off valve is in its central position relative to the main valve, and if the cut-off edges were then "line and line," the cut-off action would evidently be the quickest possible; and the fallacy of the common statement that the quickness of the cut-off is due to the fact that main and cut-valve move in opposite directions, becomes evident, for, as in the present case, the cut-off may become quicker if the main valve does not move at all. The superiority of the independent cut-off lies in the facts that no restriction of the main port-opening is required, and that the cut-off may occur when the virtual, or equivalent cut-off eccentric is near the middle of its throw.

THE MEYER CUT-OFF DIAGRAM.

The essential data required for the design of the Meyer cut-off mechanism, can now readily be obtained. The lower circle, Fig. 3, represents the path of the main eccentric. At the end of the horizontal diameter, and with radius equal to the lead, make a small circle, as shown, and draw a chord touching this circle, and whose projection on the diameter of the eccentric-circle bears the same proportion to the whole diameter as the distance traversed by the piston before steam is cut off by the main valve bears to the whole stroke, and which, in the present case, is supposed to be as 3 to 4. A radius at right angles to this chord indicates the position of the main eccentric B when the crank is at its dead center at C. With a radius of somewhat smaller than that of the main eccentric, draw a circle directly

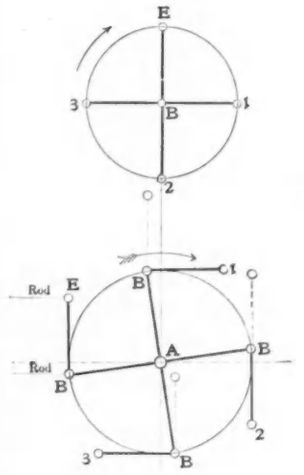


Fig. 2

RELATIVE MOTION OF ECCENTRICS.

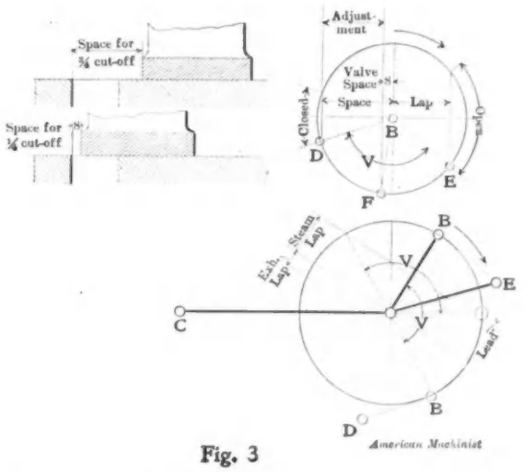


Fig. 3

LAYING OUT THE VALVE.

above, as shown. This circle represents the path of the equivalent cut-off eccentric. The extreme range of adjustment of the cut-off valve, relative to the port on the back of the main valve is indicated to the left, where the cut-off valve is shown in its middle position, adjusted for earliest and latest cut-off respectively.

First fix the cut-off position of the equivalent eccentric when the valve is set for latest cut-off. For reasons which will appear afterwards, this position should be near the extremity of the throw; let it be at D in the upper circle. When the position has traversed three-quarters of its stroke the equivalent cut-off eccentric is at D at the instant that it closes the port and, therefore, by marking off from D backwards the three-quarter stroke angle V the point E is located, which marks the position of the equivalent eccentric when the crank is on its dead center at the commencement of the stroke, and by transferring the arm $B\,E$ to a parallel position on the main eccentric circle, as shown, the proper location of the cut-off eccentric relative to the crank is obtained. The speed of the engine is, in the present case, supposed to be regulated by a throttling governor and the point of cut-off will only be varied occasionally to suit the load or steam pressure, and it is, therefore, not necessary to cut off the steam earlier than at one-quarter of the stroke. Make angle $E\,F$ equal to the quarter-stroke crank angle and F will mark the one-quarter cut-off position of the equivalent eccentric, and the distance of F from the vertical center line gives the negative lap or valve space for earliest cut-off, while the valve space required for latest cut-off is given by the horizontal distance of point D from the center line; and the horizontal distance between these two points represents the entire range of adjustment of the cut-off valve in the present case. If earlier cut-off is required the valve space must be made smaller. For cut-off at one-eighth of the stroke, the cut-off edges would coincide, and for still shorter cut-off the valve would over-lap the port in its middle position. The motion is quickest at the middle of the throw, and the quickest cut-off is that which occurs at or near mid-throw of the equivalent eccentric. The radius of the eccentric circle may represent maximum speed of relative motion at mid-throw, and at other points it is represented by vertical ordinates to the horizontal diameter. It will be seen that sharper cut-off could be had for the entire range by moving point D further back on the circle, but this would also throw point E further back and would increase the diameter of the cut-off eccentric and as it so happens that a sharp cut-off earlier in the stroke is of more consequence than later in the stroke, the arrangement here shown is generally adopted. Thus it appears that the design of the Meyer valve gear is restricted by a desire to keep down the size of the cut-off eccentric, and it will also be readily seen that the eccentrics can not very well be of same diameter unless the range of cut-off be limited to five-eighths of the stroke. The latest cut-off may occur before the main port is closed and in that case the short period during which the cut-off valve is closed, as shown on the diagram, must be taken into account, for otherwise it may happen that the cut-off port is open again before the main port is closed. The location of the cut-off eccentric when the main port is closed is found by marking off the corresponding crank angle from point E forward.

It will probably be admitted that the graphical method here shown is simpler than that invented by Dr. Zeuner, but the

greater advantage of the method here presented lies in the fact that the geometrical construction is less artificial and may readily be reasoned out and may therefore be retained in the mind more readily than any process that must be learned mechanically, and which requires a somewhat complex geometrical construction which must be produced before the problem is considered. For the sake of simplicity and clearness, it seems better to use the simple Sweet diagram for the main valve and treat the cut-off valve separately, for nothing is gained and much may be lost by drawing so many lines and circles in one figure. It should also be considered that the planing of the valve motion and not the drawing of the diagrams takes the designer's time. It does not pay to rub out many lines and draw others in their place, for paper is cheap and the drawing of a fresh diagram requires but little time, and this time is of little consequence if the valve gear to be designed is worth anything.

LIMITATIONS OF THE MEYER CUT-OFF.

The Meyer valve gear is admirably adapted for hand adjustment, but the adjusting screw may be operated by the governor. This may be accomplished by means of a rack and pinion, but the motion required and the friction of the screw are unfavorable conditions for a satisfactory regulation of the speed of the engine, and the difficulty is increased by the fact that if the range of cut-off is to extend to the beginning of the stroke, the adjustment of the slides will be about twice that required if the cut-off is beginning at one-quarter of the stroke. By making the right-hand screw and left-hand screw of different pitch, the cut-off can be made to conform closely to the irregularity of the piston motion caused by the angular motion of the connecting rod.

Brass Founding—Yellow Brass Scrap

BY C. VICKERS.

As remarked in a former paper, scrap yellow brass is sorted into two classes, heavy and light. Articles that originally were cast are called heavy scrap, and rolled material makes light brass scrap. Where scrap is used in making castings of red brass, or bronze, it is always desirable, unless the work is of low grade, to add a certain amount of new metal to each heat to give life to the whole, the amount of new metal being according to the quality of the intended castings. With light yellow brass scrap, this is not so important, but it is often desirable to add considerable new metal when heavy scrap is used. The reason for this is that the heavy or cast scrap carries more oxide into the metal than the light or rolled scrap; then, again, the composition of cast scrap is more variable than the rolled. It is very difficult to sort and classify yellow brass scrap, as it all looks alike, and all yellow as you view it in the scrap pile. Some of it may be composed of good honest copper and zinc, and some, again, of copper and zinc and as much lead as it will carry. Then, we may discover iron or aluminum in our castings when they come out of the sand, and it is of course impossible to tell what particular piece of scrap did the mischief. This, however, is one of the chances we must take when using scrap material.

If the castings turn out discolored black, a little phosphorus is generally effective in dealing with this trouble. Stir in a piece about three-quarters of an inch in length to 100 pounds of metal just before pouring. If the discoloration is of a bluish white, aluminum has caused the trouble, and phosphorus will not remove this, but the tumbler may, and if it does the aluminum will not injure the castings, provided there is no "dirt" or "flaky" spots visible on them.

If there be dirt, it is not always the metal that is to blame; for the dirt may be sand cut from the surface of the mold or the gate. Should this be the trouble, you can caution the molder and use up the defective castings among the gates as usual. If the trouble is caused by flaky spots, however, they will only reappear if the same metal is cast over again; so do not waste time with it, but portion out the defective metal among new material in succeeding heats. There is a saying that "there is never an effect without a cause." This is both; the effect of aluminum and the cause of anxiety. Copper, or any of its alloys, as well as yellow brass, is liable to show this defect when aluminum is present. When aluminum comes into contact with any metallic oxide, except magnesium, and heat is applied the aluminum greedily seizes the oxygen from the other metal and unites with it to form oxide of aluminum. When there is sufficient oxygen to form a combination with all the aluminum, the other metal is left in a state of purity and the alumina floats on top as a slag. The thing desirable, therefore, is to know exactly how much oxide is dissolved in each heat, and add just sufficient aluminum to reduce it. In order to determine this, it would be necessary to take an analysis of each pot of metal. As the oxide of copper is a variable quantity, this of course is not feasible in ordinary practice, so that the employment of aluminum as a deoxidizer is not advisable, because its presence in the metal causes new troubles that are more difficult to contend with than the copper oxide.

When aluminum is alloyed with copper, to form aluminum bronze or brass, there is always a difficulty in making clean castings, and many schemes have been devised to prevent oxidation in transferring the metal from the furnace to the mold. As the film of oxide, which forms on the surface when the metal is exposed to the atmosphere, cannot be detected, in ordinary pouring it enters the mold, and, being lighter than the metal, it will be found on the upper surfaces of the casting generally gathered in one or more places where the movement of the metal has deposited it. In appearance these defective places often suggest the idea that the metal had saponified in pouring, forming a lather much like soap-suds, which had been flattened out against the upper surface of the mold by the pressure of the fluid metal behind it. Sometimes the metal can be picked off these spots in flakes or splinters by the point of a knife. Generally they are a little whiter than the sound metal externally, and appear to the writer to be composed of an alloy of copper, aluminum and oxygen. According to a well-established chemical law, all bodies unite with each other in certain definite proportions, which proportions are constant. Aluminum combines with oxygen to form oxide of aluminum, or alumina, in the proportion of two atoms of aluminum to three of oxygen. This oxide is very hard and resembles emery, and when the combination takes place in alloys of copper and aluminum, it would float on the top as a slag, and could be removed or held back by the skimmer. Probably this action does take place until all the oxide in the copper is abstracted, a small proportion of the aluminum being lost in the process. But the aluminum is still in excess and looking for more oxygen; so when the surface of the molten metal is exposed to the atmosphere, chemical action takes place, and results in the formation of a substance which is not alumina but which may be a triple union of oxygen, copper and aluminum, and is the cause of the trouble we have been considering.

To avoid this trouble, oxidization must be prevented. In casting large pieces of aluminum bronze this is often attempted by bottom pouring. A hole is made in the bottom of a crucible which is of sufficient size to take all the metal necessary for the casting (or more than one crucible is used if necessary). A bar of iron insulated by fire-clay or plumbago baked on is fitted to the hole as a plug, the crucible when cold is bedded above the pouring head of the mold. Before pouring it is removed, heated cherry red, replaced in position over the head, the hole plugged by the hot iron bar held vertically in the crucible, then the metal is all poured in, and when at the right temperature the plug is removed and the metal enters the mold, the stream coming into contact with no more air than the mold contains. Flow-offs are placed to take care of the surplus metal. If the work is too small to adopt some such expedient as the foregoing and yet causes trouble, give up the job or change the metal. The writer has known a firm to spend hundreds of dollars in endeavoring to make castings of aluminum brass, and, it is safe to say, nothing would tempt them to try it again. They paid for their experience and changed the

metal. Another firm has invested thousands of dollars trying to deoxidize copper by means of aluminum to obtain a metal solid and possessed of a high electric conductivity. As a result of many expensive experiments, they have established a rule that fixes the amount of aluminum to add to a given amount of copper, in which they have absolute faith, and in spite of failure after failure, caused by flaky spots, they are hoping and persevering, laying the blame on the molders and the furnacemen and everything but the right thing, the aluminum. We will now turn to the consideration of the brass scrap, trusting that the importance of the subject will be sufficient excuse for this digression on the effects of aluminum on copper and its alloys.

As before stated, it is not generally necessary to mix new metal with light yellow brass scrap, because rolled metal is uniformly of good quality and generally very little oxidized. Its greatest drawback is its lightness, which makes it difficult to handle when melting down, as it takes so much of it to fill a pot that it keeps a man busy charging. It should never be charged loose, as it is impossible to prevent some of the metal from falling outside of the pot into the fire, where it disappears like a flash, making the percentage of loss large. It should be pounded into balls of a size convenient to enter the crucible. The iron mortar in which it is usual to pound rosin will suggest itself as being suitable for this purpose. There is considerable loss in making and melting yellow brass, as the zinc is a very volatile metal at high temperatures. It combines with oxygen to form zinc oxide, which fills the shop with smoke and floats around in little flakes. With the most careful melting this loss amounts to one and a half ounces in three pounds of metal.

Careful melting means to keep the surface of the metal covered with some flux, such as charcoal, glass, etc., and to keep the temperature of the metal below the smoking point as much as possible during charging. Some furnacemen require considerable watching on this metal. They will urge the fire the same as for bronze, and forget all about it until they see a dazzling light under the furnace lid, when they will rush over, throw in more metal and repeat the performance until the pot is full. Then often they will leave it boiling there until the molders are ready for pouring, and when the pot is taken out of the fire, in spite of all the fluxes that can be used, the top of the pot will be found covered with a thick, white crust of zinc oxide, which will be pierced here and there with holes around which hills of oxide have been formed giving the appearance of little volcanoes, which is further hightened by the flashes of flame which spurt out of them. With such methods the loss of metal is surprising. If the fire must be forced in order to get the metal out quickly, it will require constant watching and charging of new metal to keep the temperature low until the pot is filled, after which it can be quickly raised to the heat necessary for pouring. When remelting yellow brass, either scrap or gates, it is a good idea to add one pound of zinc to every twenty-five pounds of metal to allow for loss.

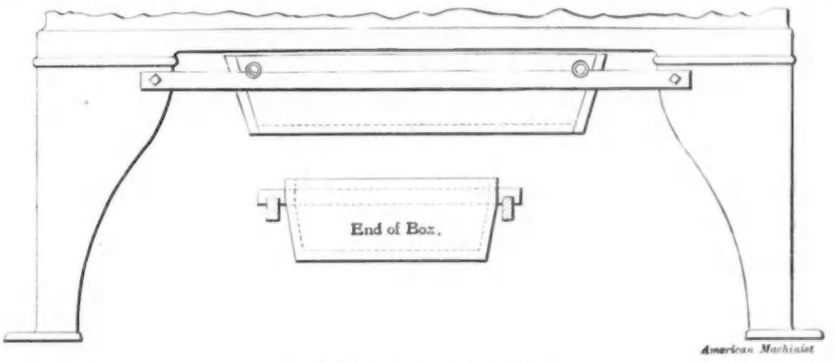
With regard to suitable fluxes for yellow brass, some foundries use the following: Salt cake, or crude carbonate soda, 5 parts; silica (white sand), 15 parts; coal dust (anthracite), 5 parts; bone ash, 20 parts. Mix and cover the surface of the metal, stirring it in before superheating.

Letters from Practical Men

A Chip Box for the Lathe.

Editor American Machinist:

Another lathe attachment—there are so many already—but here is something I devised to attach to our lathes to catch chips, borings and lubricants, and it serves its purpose. The whole thing consists of a box, two pieces of ⅜x1-inch iron and two short pieces of ⅜-inch pipe. The ⅜x1-inch strips or rails are fastened to the lathe legs close under the beads with a ½-inch cap screw in each end. The box is made of any desired length and of a width to go between the rails. The pipes which pass through the sides of the box close to the ends have notches cut in them to keep them in place and to steady the rails. The rig is inexpensive, easily put on, is not in the operator's way. If it was slightly modified, so as to do away with the rail and provide a substantial pressed steel box, hung directly on the lathe bed, it would be a very good thing for builders to put on lathes regularly. To empty the box, one of the short pipes in the end is removed, which allows that end to come down and empty the borings into a wheelbarrow or box. We find it, however, quicker to have a laborer go around with a wheelbarrow and, with the assistance of the lathehand of each lathe, lift the box down bodily by removing both pipes and empty the box into the wheelbarrow. This operation takes about half a minute, and we think preferable when the boxes are not too heavy. The boxes intended to catch water or lubricants are made watertight and a hole bored in the bottom to drain into a receptacle; when not using lubricant, cork the hole.



A CHIP BOX FOR THE LATHE.

ARTHUR H. GANG.

Cincinnati, Ohio.

Rules for Integral Right-Angled Triangles.

Editor American Machinist:

Apropos of your article in issue No. 40, on "Table of Integral Right-Angled Triangles," and hint to place the same in pocket-books, it may interest some of your readers to have some rules whereby such triangles may be obtained. Below are a few:

(1) Take n, any *odd number*, then $\frac{n^2-1}{2}$ = second number, and $\frac{n^2+1}{2}$ = third number.

(2) Take n, any *even number*, then $\frac{n^2}{4}-1$ = second number, and $\frac{n^2}{4}+1$ = third number.

(3) Let b = one side, and take x and y, both odd or both even, and such that $x\,y = b^2$. Then

$$\frac{x-y}{2} = \text{the second side,}$$

and $$\frac{x+y}{2} = \text{the third side.}$$

J. E. G. YALDEN.

Baron de Hirsch Trade School, New York.

Poleforcia.

Editor American Machinist:

Your article in the "American Machinist" No. 36, about "POLEFORCIA," is one of those kind of articles which we do not complain of, we haven't the least objection to fair criticism, but we would like to point out this, that American citizens are very kindly disposed, and easily persuaded to invest in new things, and this characteristic on the part of my Countrymen has been taken advantage of, by such enterprises, as Electric Sugar, and Keely Motor. This has happened so often to them, that when they saw, registered 105

Electric Horse Power, in a Dynamo, only 22 (Twenty-two) Horse Power by Indicator on a driving Engine, which driving Engine was provided with a ponderous great wheel, of 15 feet diameter, with 5,800 (Five thousand, eight hundred) Pounds in the rim of said Fly-wheel, they would rather believe that the Electricity didn't come, from that great wheel, but that it really, was provided from some other source, a wire through the fence.

It is not necessary for us to defend the splendid staff of careful, painstaking, and courteous gentlemen, who act as the Examiners, in the United States Patent Office, at Washington. This case, after years of trouble, was allowed on demonstration, by the Board of Examiners in Chief of the United States Patent Office.

Yours truly,

B. C. POLE.

London, England.

Some Special Uses and Some Special Forms of the Richards Side Planing Machine.

Editor American Machinist:

I notice with much interest the special shaping machine shown in a recent number of your journal, for planing out the bearing seats of large engine frames. The manner in which this machine is specially adapted to the work to be done, is a very interesting example of special machine design. I appreciate some of the difficulties of this particular problem, from the fact that we have been called upon, as makers of open-side planing machines, to adapt these machines to this work, but the overhang of the arm becomes so increased as to cause a weakness in the design, to say nothing of the extreme cost of a machine of this type.

We have prepared a planing machine of a portable nature to plane out the bearing seats of these large engine frames, and I send you a drawing of the machine [Fig. 1], which I hope you will agree is also an interesting example of the application of a special planing machine to this kind of work. You will notice that the bed of the engine is placed upon a sole plate and the planing machine is then lowered into its place in the engine frame by the crane. It is then bolted to the plate on which the engine frame rests. These large floor plates are found in most engine shops here, forming part of the boring-machine plant. In some of the larger shops, the plate is fitted with several portable boring heads, radial drills, face-milling machines, etc., to complete all the operations on the engine bed while it is on the floor plate.

We are called upon to plane more than one surface at a time and as the conditions seem to be suitable, we arrange the machine to plane in both directions, one tool cutting in one direction and two tools in the other, as indicated.

The development of large engines on the Continent for high speed in which the main bearing is cast as a part of the frame, has caused this question of planing out the bearing seats to become one of considerable importance, and as such development is no doubt also taking place in the United States, I send this drawing to show what is being done here.

A photograph is also sent [Fig. 2] showing the application of our ordinary open-side planing machine to the planing of the crank-shaft bearings of compound engine frames, in which instance the arm projects sufficiently to reach over the planed surfaces. It is one of the interesting applications of the open-side planing machines and may also be of interest to your readers. Some photographs [Figs. 3 and 4] are sent, showing how the frame of a small marine engine was planed all over, viz., both ends of the condenser chamber, the slides for the cross-head, the feet for attaching to the bed-plate and the top flanges to receive the cylinders. Several settings were required for the planing, but the result was extremely satisfactory.

I have just received a photograph of one of our double open-side planing machines [Fig. 5], which has been erected at the Allmänna Svenska Electriska Aktiebolaget, at Vesteras, in Sweden. The machine

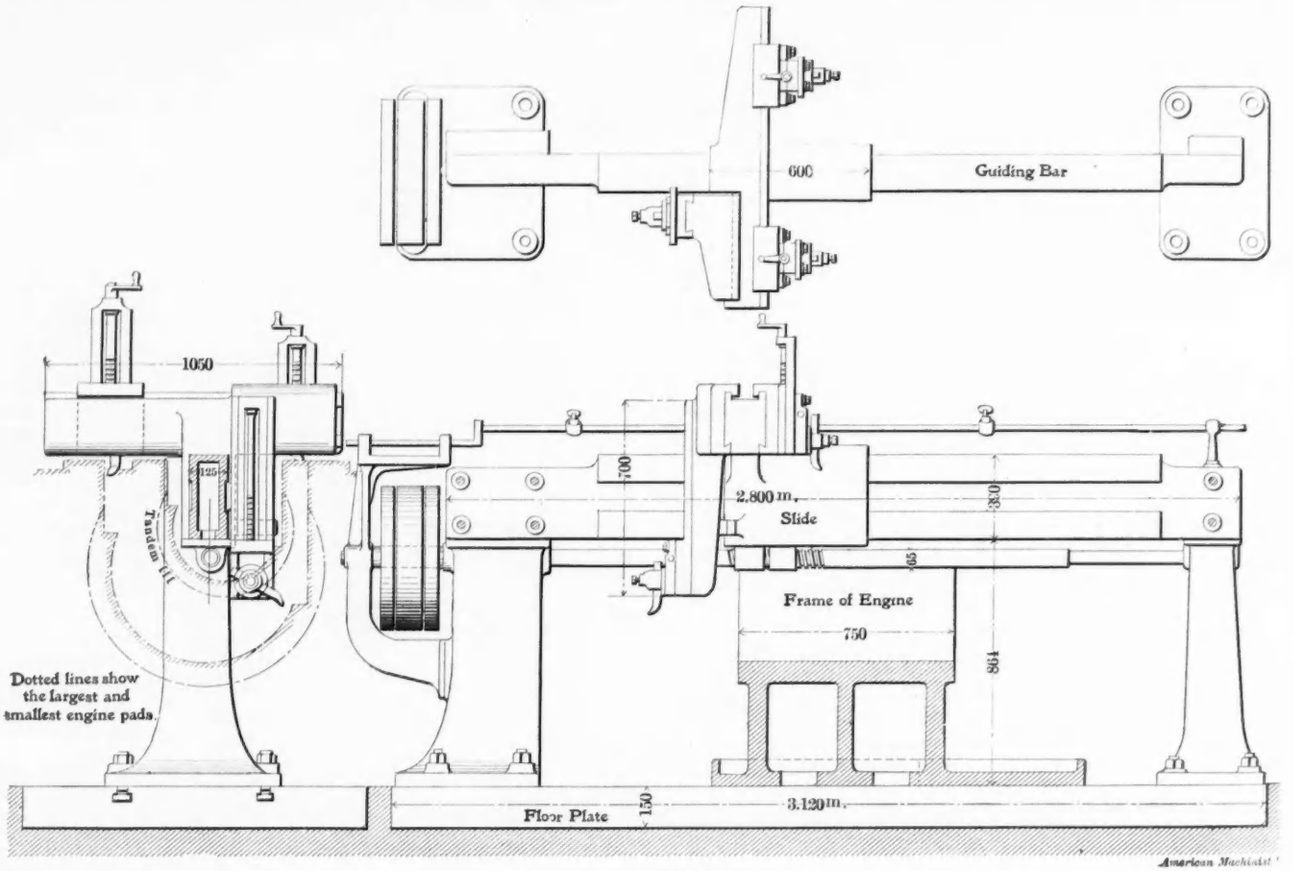


Fig. 1

SPECIAL PLANING MACHINE FOR THE MAIN BEARINGS OF LARGE ENGINES.

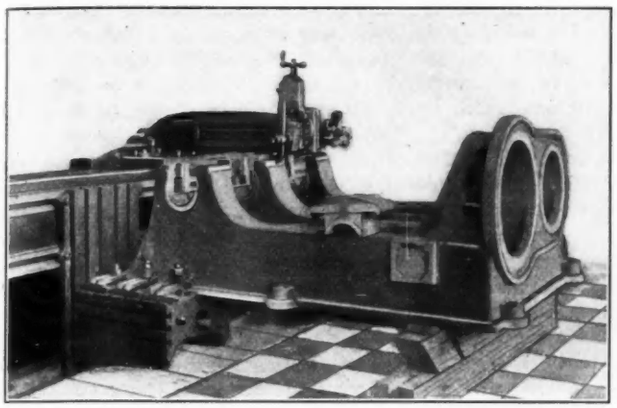


FIG. 2. PLANING SEATS FOR CRANK-SHAFT BEARINGS.

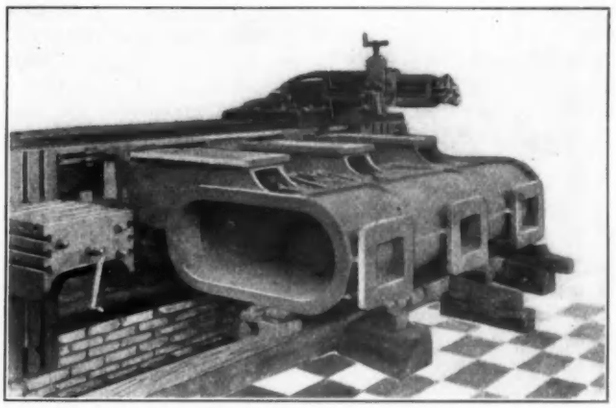


FIG. 4. PLANING THE BED OF A SMALL MARINE ENGINE.

was specially arranged for planing the halves of large frames for dynamos, as you will see from the photograph. One machine is fixed stationary on the floor, while the other is arranged to travel to and fro from the other on two bed-plates. The machine is moved by two screws underneath the floor so as to be kept as near parallel as possible to the other. You will also notice that the countershaft which is driven electrically, is also supported by the frame of the machine so as to move with it. [The one on the fixed machine seems to be arranged similarly so that the crane can pass over it. ED.]

This installation is very well carried out and it also illustrates one of the special demands for machine tools to cheapen production.

To judge from what I saw on my last visit to the United States, I do not think that the advantages of the open-side planing machines are sufficiently understood, nor the possibilities of this important machine fully recognized. There are many pieces of work which can be planed on this machine which would be found difficult and often impossible to plane with the ordinary type of planing machine. At the same time the open-side planing machine is equally well adapted for planing pieces of ordinary character. It is, therefore, in one sense of the word, a special planing machine and yet one which can most of the time be employed for general work.

I may add, as a matter of interest to you, that when I first undertook to place this machine on the market in England, it was regarded as altogether too special in design, and I was told that it would never become a salable machine. To-day, so far as I can ascertain, there are eleven makers of open-side planing machines in various parts of the world, all of them following the same model as established by my father at San Francisco, about 1881. I do not recall the history of any machine tool in recent years which presents so striking a contrast between its first reception by the public and its final adoption in hundreds of works as a standard machine.

There are many works using four to six of these machines, and one large works on the Continent employs seventeen, ranging in size from the smallest to the largest capacity.

GEO. RICHARDS.

London, Eng.

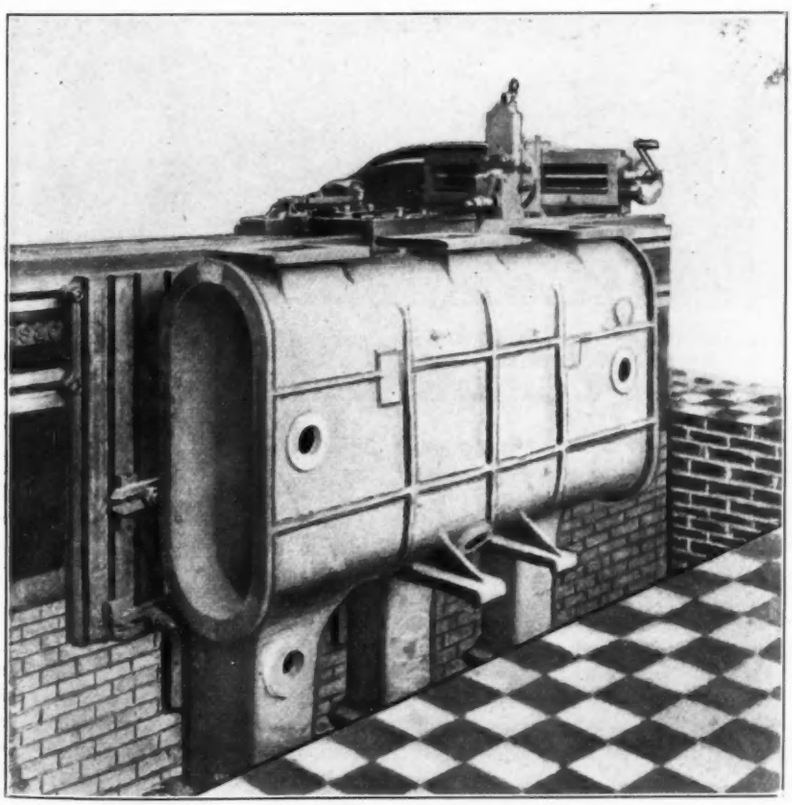


FIG. 3. PLANING THE FRAME OF A SMALL MARINE ENGINE.

Unlimited Power Waiting to be Tapped.

Editor American Machinist:

The fear of a threatened coal famine, owing to the strike in Pennsylvania, which has no doubt worried central-station managers in this vicinity, has been removed! No longer are we miserable consumers of power under the thumb of the "coal barons"!

"The production of *immense power*, with *comparatively no cost* in fuel" is a solved problem, and the Power Multiplying Engine Company, of New York, having solved the problem, proposes to generously "let us all in" for the small sum of $3 per share, and not more than five shares to any one person.

Think of it: "One half-ton of pea coal per day of twenty-four hours will furnish the power necessary to run any electric plant."

Shades of Liquid Air, Keeley Motor and Franklin Syndicate, where are ye? Walk up, walk up, gents, and see the motor mote. Bring on your half-ton of pea coal, and likewise your "Oceanic" or your "Deutschland," and ho! for Europe. Have not the scientists and engineers reported favorably on it?

All these years we have had "natural" air floating around us just aching for a

job, and now it is collared, and put to work by "leting [*sic*] it run like water." I suppose if the supply of "natural" air runs out, owing to the liquid-air demand and the needs of the power multiplying engines, we may have to use second-hand air to breathe.

You will note (see *intelligible* circular) that "after the resistance from in front of the piston is removed," and the natural air gets its fine work in on the rear end of the piston, it is good-bye to the piston—"it is forced into space." I think if any "come-ons" subscribe any $3 or more, that after the resistance is removed from the front of receiving teller's department of the Power Multiplying Engine Company, and their "natural air" gets its fine work in, the aforesaid $3 will "disappear into space" also.

You will notice that one of our evening "yellows" is quoted in support of the marvellous claims of the "natural" air pumpers. How appropriate! The inventor doesn't want the "avaricious capitalist" to have a show; but if the green-goods and gold-brick buyers, who are to get *better* than $4,000 for $1, are not avaricious, what are they? S. M. ALLSHOP.

[The following is a copy of the letter or circular (imitation typewritten) to which our correspondent refers. The scheme seems to be sufficiently indicated without further explanation. Of course if a vacuum is created before the piston, the pressure of the air behind it will drive it along; but it will always take much more power to produce the vacuum than can be realized from the resulting unbalanced air pressure.

There are really better schemes than that of the Power Multiplying Engine Company. Say that we have a horizontal beam fulcrumed at the middle with heavy equal weights suspended from the ends. Now, if one of the weights be merely slid off its suspending platform, without lifting it at all, we have the entire weight at the other end of the lever ready to supply us with power by its descent. If that is not power for nothing, then we don't know what is.

The circular is accompanied by other printed matter, among which is a copy of a letter, assumed of course to be one of endorsement, signed by W. Barnet Le Van, M. E. The letter would occupy more than one of our columns. We are glad to state that it very distinctly does not endorse, or, in fact, even allude to the "power for little or nothing" feature, which is *the* feature of the scheme. The article from the New York Evening "Journal" also has "nothing to do with the case."]

"Dear Sir—We desire to call your attention to the fact that you are wasting money every day, that you can save and turn to profit for yourself if you will read carefully this letter and the rest of the enclosed matter and then profit by what you have read.

"It will save you money if you get the following items of daily expense at less than one-half of the present cost. Your railroad fares, steamship fares, electric light, electric power, power of any kind, all kind of goods requiring power to manufacture.

"These are some of the things that we are sure to do if you will join and aid us and yourself by making the small subscription we ask you to make with profit to yourself.

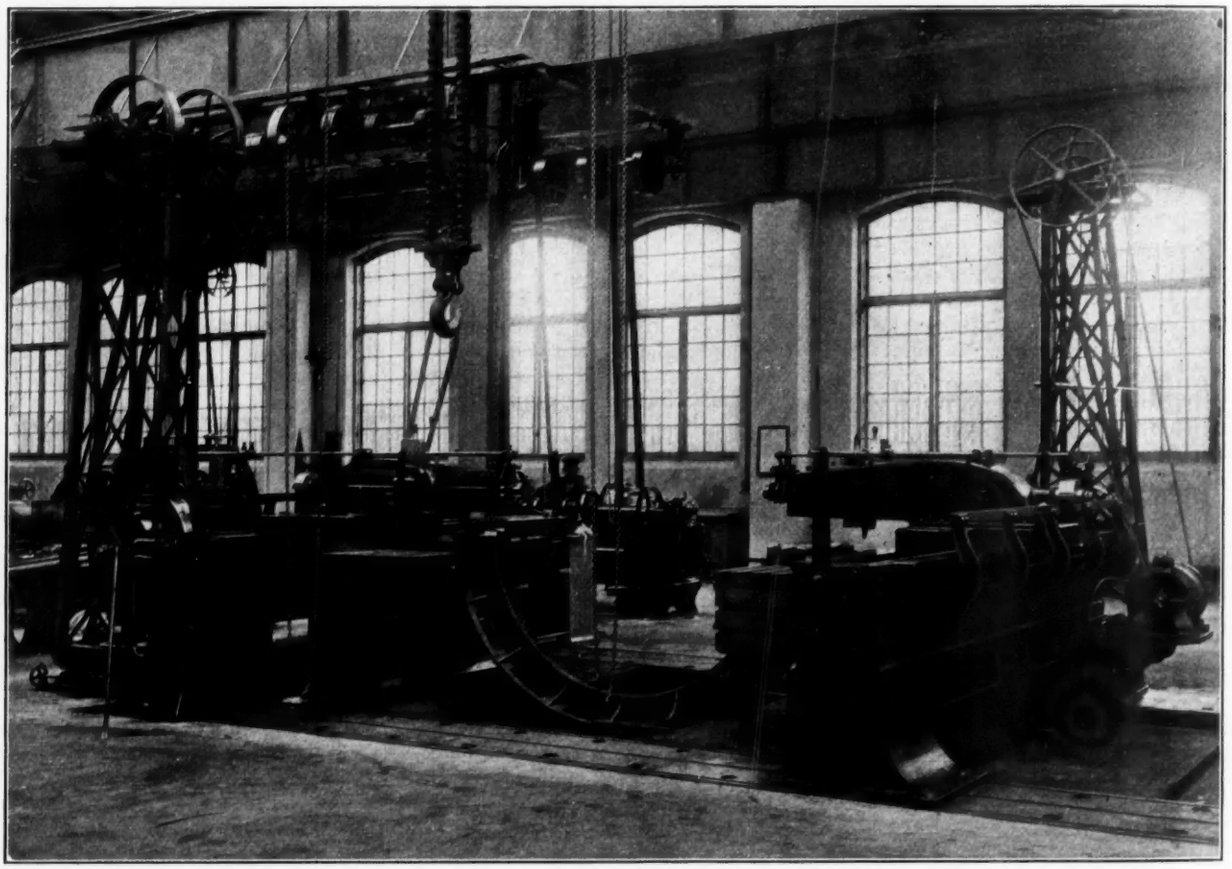


FIG. 5. DOUBLE SIDE-PLANER AT WORK ON DYNAMO-RING IN A SWEDISH SHOP.

"At the present time all power in use is created by the use of steam in large quantities; it is this we propose to remedy with the aid of the general public to its advantage.

"Comparatively the only cost in producing electricity is the immense amount of coal required. Now, we claim and will show that we can furnish the electrical power necessary to run any electric light or railway plant on the steam produced from the consumption of one-half ton of pea coal per day of twenty-four hours. Our experience and experiments prove conclusively that compressed air and power to run factories and steamships will require no more coal than electricity does by our system.

"This is not a fairy tale. It is a well-known fact that up to the present day those seeking power at comparatively no cost locate at or near a running stream of water, like Niagara Falls and rivers, and for that reason at this time many efforts are being made to use the wave motion of the ocean; but it does seem peculiar that with all of this effort to find a cheap power, no one should have thought of natural air, which has a greater force than water (as illustrated at Galveston, Texas) and can be had everywhere, and can be made operative at comparatively no cost by leting it run like water. This is just what we do.

"The principle by which we accomplish the results named above is pneumatic, and is had by using a vacuum pump requiring 60 pounds of live steam to operate it, which will require but one-half ton of coal each twenty-four hours; by this means we remove the resistance from in front of the piston of the engine and allow the full pressure of the natural air (15 pounds to the square inch) to become operative on the rear or driving end of the piston, forcing it into space. This construction of the engine enables us to use on any engine as many cylinders as we may desire, with each cylinder having the same driving force. That would be 400 pounds on the driving end of the piston in each cylinder 6 inches diameter. That is to say that the one pump, using but one-half ton of coal each twenty-four hours, will operate one or forty cylinders without trouble. With a view of bringing the pneumatic system to you so that you will comprehend it readily and without any trouble, we enclose an editorial of the New York 'Evening Journal' of July 6, 1899.

There has been no proposition offered to the world in modern times which has such immense magnitude and great possibilities, and your own good common sense must show you conclusively that when we have completed our commercial development, that although we reduce the cost to the consumer, more than one-half the profit to the investor will be so large that he will not need a large holding to make his income from the investment very comfortable.

"This company, when it grants a right to a sub-company or an individual to use this system, will insist on a guarantee in its contracts that will insure not only the lower prices for all commodities that it reduces the producing cost, but will also while reducing the cost to the passenger and freight, insure the same price per mile for freight and passenger everywhere and to each individual alike.

"We have tried to cover the ground as briefly as possible and at the same time make it intelligible, but we will be pleased to give any further information on application. Very respectfully,

"C. H. GOEBEL, President.

"$3 per share; par value $20."

The New Labor Organization in the Machinery Trades.

Editor American Machinist:

I was much interested in reading the notice in your No. 42, page 988, of the movement inaugurated last summer in this city, for the peaceful adjudication of labor disputes. This new labor union is a decided step towards industrial peace, and in these days when strikes are costing the country so many millions of dollars and so many hundreds of lives, any tendency of this kind is to be earnestly fostered. To my mind, the greatest evil which results from these clashes is not the financial loss nor even the loss of life, but rather the great increase of class feeling and bitterness. Here lies the greatest danger to our country with her democratic institutions, and for this reason, if for no other, I believe that strikes not only should be deprecated to the last, but I would go farther and say they should positively be prohibited by law. This method, of course, involves "compulsory arbitration," and to this course there seems to be a prejudice in the minds of many. After visiting New Zealand, two years ago, where a most complete system of compulsory arbitration is in vogue, I was struck by the usefulness of such a law. It saves their little country millions every year. After a short investigation on my return home, I found a strong feeling among many of the more intelligent mechanics that strikes should be relegated to the past, and there was a deep-seated conviction that they would be greater gainers with an arbitration agreement with their employer than by any other method. It was thought an union formed upon such a rational basis should meet with the approval of both the employer and employee, and with this idea in view the Machine Trades and Professions Association was formed. Much good has already resulted and much more is looked for. It is hoped that a national organization may result and that the sentiment for arbitration as opposed to brute force may be widely strengthened. I have imposed very largely upon your time, but have taken the liberty, knowing your interest in the labor question.

ROBERT H. JEFFREY.

Columbus, Ohio.

Circulation in Water Tube Boilers.

Editor American Machinist:

I note in your issue No. 42 a letter from Wm. H. Harrison in reference to my friend Richards' description of an experimental coil in issue No. 38. Mr. Richards' Figs. 1 and 2 do not quite correspond. In Fig. 2 the steam and water reservoir is not shown, and the upcast pipe *P* is erroneously marked "to engine," whereas it should lead to the steam reservoir, as in Fig. 1, to complete the circuit. So far as I have been able to learn, the economy of having the feed water enter nearest the chimney and flow constantly in the direction of higher temperatures of furnace gases was first stated by Rankine. Belleville started on that idea in 1856, but both he and Herreshoff failed from the same cause, viz.: they both depended on a "pumped circulation." Gravity is the only force which can be depended on under all conditions for circulation in steam boilers. Either the Belleville or Herreshoff device would operate without much trouble with the reservoir above, as in Mr. Richards' Fig. 1. It seems to be a well-rooted idea among engineers that the water must enter the hot end of the coil or element, as in the Belleville, to prevent overheating the lower tubes. M. Bertin states that when the economizers were added in the "Diadem" class, the question came up, and it was considered unsafe to feed into the top of the economizer coils or elements. I see they have been having trouble with these economizers. It might interest Sir John Durston and the recently appointed Boiler Committee to know that there are elements in daily operation here which receive their supply at the "cold" ends from a drum and discharge the steam from the "hot" ends to the steam space, and which compare with the Belleville as follows:

Belleville—Number of elements in boiler, 8; number of tubes each, 14; length of tubes, 8 feet; outside diameter, 4½ inches; thickness, ¼ to ⅜ inch; total length of element, 112 feet; length of tubes between support, 8 feet; with ¾-inch draft, tubes bend and leaks develop.

Downflow—Number of elements in boiler, 8; number of tubes each, 15; length of tubes, 18 feet; outside diameter, 3 inches; thickness, ⅛ inch; total length of element, 280 feet; length of tubes between support, 18 feet; with ¾-inch draft, no bending or leaks.

These elements will stand 30 pounds coal per square foot of grate, 24 hours per day, 7 days per week, and I do not know how much more, as I have not tried. These tubes are standard charcoal lap-welded tubes. One boiler has been in daily use for six months. JOHN C. PARKER.

Philadelphia.

Some New Things.

MEASURING BLOCKS AND PLANER PARALLELS.

The specialty of the shops of O. S. Walker & Co., Worcester, Mass., is the manufacture of magnetic chucks, which have been illustrated and described in our columns. This line of business affords facilities for accurate planing and a special appreciation of planer conveniences, which have combined to lead the firm into the manufacture of parallels and measuring blocks for whoever may want them. No machinist of course need be told of the convenience of these things, especially about the planer and shaper and also often on drills, boring mills and elsewhere.

A set of the parallels is shown in Fig. 1. The set comprises thirteen pairs, the smallest being 13-16x⅜x6 inches, and the larg-

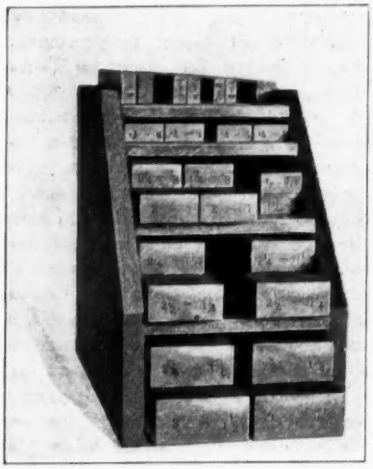


FIG. 1. A SET OF PARALLELS.

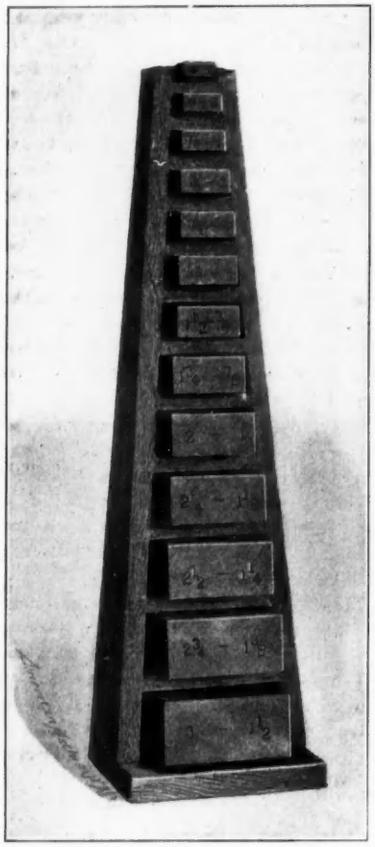


FIG. 2. MEASURING BLOCKS.

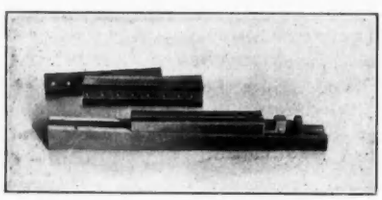
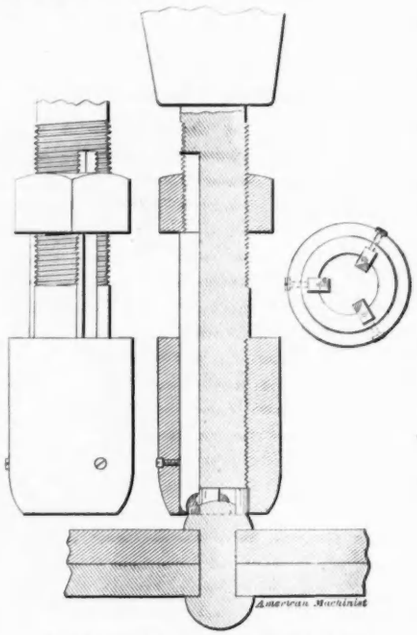


FIG. 3. ADJUSTABLE PARALLELS.

est 3x1½x16 inches, the variations of thickness being by sixteenths and the widths being about double the thickness. The parallels are claimed to be absolutely square and the limit of error for thickness is .0005 inch. The ends are milled, beveled and stamped with the dimensions and mounted in an oak cabinet. A cheaper grade of parallels, not so minutely accurate, is made.

The measuring blocks, thirteen to the set, from ⅜ to 3 inches in thickness, varying by sixteenths, are shown in Fig. 2. These blocks are valuable as a substitute for the graduated scale and the surface gage for measuring on the planer, shaper, milling machine, or elsewhere when accuracy is required.

Fig. 3 shows an adjustable parallel which explains itself. The base is planed and grooved in a single piece, 36 inches long, and then cut into three pieces and drilled for the stem of the adjusting block. This block and its thumb-screw hold the upper piece of the parallel wherever it may be wanted.



A TOOL FOR CUTTING RIVET HEADS.

The cut shows a tool for cutting away rivet heads when the rivets have to be removed for repairs or for other reasons. It is an end-cutting tool, used generally in the spindle of an upright drill. On a spherical or conical rivet head it will generally locate itself with sufficient accuracy and will cut to something less than the diameter of the body of the rivet, cutting away the outer portion of the head all around until the flat surface of the sheet is reached, when the rivet may be driven out. The stem is grooved for three cutters. The cap or sleeve screwed on the lower end of the stem has also shallow grooves for the outer edges of the cutters. The sleeve is first screwed on to the stem in its proper position and the cutters are then slipped in, the little screws in the sleeve being sufficient to hold them. The upper ends of the cutters abut against the face of the large hexagon nut. The cutters may be removed for grinding on the ends, and as they become shorter the nut is adjusted to bring the cutting ends flush with the end of the sleeve. The patentee of the device is Thomas Brown, Allegheny, Pa.

Personal.

Herbert E. Wireman has resigned the superintendency of the shop of the American Ball-Bearing Company, Cleveland, Ohio.

C. Shank, who was for a number of years foreman for the Chicago Screw Company, and Mr. J. H. Jann, who was foreman of the tool room of the Western Electric Company, Chicago, have started in business for themselves under the name of the Western Tool Works, on the fifth floor of the manufacturing building, corner of Canal and Randolph streets, Chicago. They propose to make all sorts of special tools, model and experimental work. They would like to have catalogs of makers of tools and supplies.

John Stambaugh has retired from the position of general manager of Wm. Tod & Co.'s engine building works, of Youngstown, Ohio, to take part in the management of the Youngstown Steel Company, of which he is secretary and treasurer, and with which concern he has been interested for years. Mr. Stambaugh will be succeeded as general manager of Wm. Tod & Co.'s business by Mr. M. A. Neeland, formerly chief engineer of the National Steel Company. Mr. Neeland will assume the active management of Wm. Tod & Co. as soon as his duties with the National Steel Company will permit, which will probably be about January 1, 1901.

New Catalogs.

The Societa Italiana Ernesto Breda per Costruzioni Meccaniche, of Milan, has sent us a Paris Exposition pamphlet, in French, containing a brief description of their works and of the locomotives they manufacture. Size, 7¼x9½ inches.

The Chicago Pneumatic Tool Company has sent us a copy of its Exposition Edition Catalog, filled with fine views, with explanations in English, French and German, of the com-

(*Continued on page 45.*)

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant ; see p. 22.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Forming lathes. Mer.Mach.T.Co.,Meriden,Ct.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Light and fine mach'y to order ; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies and Diemaking," $1, post paid. J.L.Lucas,Bridgeport,Ct. Send for index sheet.

"Brandt's Triple Expansion Gaskets" are the best for boilers. Randolph Brandt, 38 Cortlandt st., New York.

Wanted—To correspond with first-class foreman or superintendent who is thorough in malleable-iron foundry business, with view of opening plant ; trade guaranteed. Address S. & H., care AMERICAN MACHINIST.

Institutions retiring from business having